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The American Museum Journal

VOL. III. JANUARY, 1903 No 1.

THE Supplement to the present issue of the JOURNAL discusses in a popular manner the exhibit in the Hall of Fossil Vertebrates, illustrating the evolution of the Horse. The leaflet has been prepared by Dr. W. D. Matthew, Associate Curator of the Department of Vertebrate Palæontology, and is the first in the series of guide leaflets pertaining to the evolution of the fossil mammals as illustrated by the collections in the American Museum. Leaflets descriptive of other groups of fossil vertebrates are in course of preparation and will be issued as rapidly as circumstances permit. The study of fossil Horses at this Museum has been greatly extended and facilitated by the William C. Whitney fund, now beginning the third year of its usefulness.

DEPARTMENT OF VERTEBRATE PALÆONTOLOGY.

SECOND COPE COLLECTION.

THREE years ago President Jesup presented to the Museum the collection of fossil fish, amphibians and reptiles brought from Kansas, Colorado, Wyoming, Montana, Texas and other portions of the great Rocky Mountain district between 1868 and 1896, by Professor Edward D. Cope. There has been some delay in completing the final negotiations with the executors of Professor Cope's estate for the purchase of this and the Pampean Collection, but now fortunately the collections are available for immediate exhibition and description. This ranks as one of the most important events in the history of science in this city, since it gives the American Museum the same pre-eminence as to the older forms of vertebrates which it has held as to fossil mammals

since the acquisition in 1895 of the Cope Mammal Collection, and as to fossil invertebrates for many years by the possession of the James Hall Collection.

This new collection of reptiles, *et cetera*, covers the history of vertebrate life upon the American continent for a period estimated by geologists at seventeen millions of years. It contains animals of all kinds, terrestrial, fresh-water and marine, from the primitive fish of the Devonian period and the earliest air-breathers of the Red Beds of Texas, to the great horned and hornless Dinosaurs of the Upper Cretaceous and the small reptiles of Tertiary time which are the ancestors of the reptiles of the present day. Among the fishes are found some of the types upon which Cope based his re-classification of the group. The amphibia from the Permian or Red Beds are the most ancient of land vertebrates. They vary in size from that of a salamander to a large alligator with broad, flat heads. Associated with these forms are the most ancient types of Lizards, related to the ancestors of the Dinosaurs.

From the chalk beds of Kansas and eastern Colorado there are many specimens of the Mosasaurs which inhabited the mediterranean sea occupying that part of America during the Cretaceous period. Among these are many of the types used by Professor Cope in his description of species. A nearly complete skeleton, more than forty feet in length, of the long-necked Plesiosaur recalls one of the historic controversies between Professor Marsh and Professor Cope. The former gentleman succeeded, as is now known, in demonstrating that the latter had placed the head of this animal upon the end of its tail.

From the Upper Cretaceous or Laramie, besides one of Professor Cope's types of horned Dinosaurs there is a magnificent skeleton of Hadrosaur known as *Diclonius mirabilis*, the bones of which are in an unusually fine state of preservation. This specimen will be mounted free of the matrix, and it is of such large proportions (thirty-eight feet in length) that it will be even more imposing than the famous Iguanodons in the Museum at Brussels, to which it is somewhat closely related.

The finest specimen from the Jurassic is Cope's type of the

great Sauropod, *Camarasaurus*, the "Chambered-Dinosaur," so called from the great cavities in its vertebræ. This is the greater part of the skeleton of an animal about seventy feet in length, and it is hoped, with the aid of other material now in the Museum, that it will be possible soon to place on exhibition a complete mounted skeleton of this, the largest of known quadrupeds.

The cases in the new East Corner Wing of the Museum are now being put in order for the reception of this collection; and two preparators are working under Mr. Hermann's direction especially upon the Hadrosaur and the Camarasaur, so as to hasten forward these exhibits.

EXTINCT SABRE-TOOTH TIGER, SMILODON; SKELETON IN COPE PAMPEAN COLLECTION
RESTORATION BY WOLFF

THE PAMPEAN COLLECTION.

Presented to the Museum by several of the Trustees.

This collection, representing the Pleistocene fauna of South America, includes three series of specimens, brought together by Ameghino, Larroque and Brachet and sent by the Argentine Republic to the Paris Exposition of 1878. Professor Cope was so captivated by this collection that he purchased it outright, and

brought it to this country. For more than twenty years it remained packed away out of sight, in the cellar of Memorial Hall in Fairmount Park, Philadelphia. The Museum has acquired the collection through the generosity of H. O. Havemeyer, William E. Dodge, D. Willis James, Adrian Iselin, Henry F. Osborn and the late James M. Constable.

It includes a very full representation of the Pleistocene fauna of South America, especially of the large Edentates, *Glyptodon*, *Lestodon* and *Scelidotherium*. There are also numerous remains of *Toxodon*. Altogether there are in the collection six or seven skeletons of these rare animals which are so nearly complete that they may be mounted. The gem of the collection is a skeleton of the Sabre-toothed Tiger, belonging to the genus *Smilodon*. This superb specimen lacks only the forefeet, which will be supplied from casts taken from the skeleton in the Museum of Buenos Aires. It is now being mounted by Mr. Hermann for immediate exhibition.

The two collections together embrace about 4000 specimens and include a large number of Professor Cope's types.

THE ESKIMO COLLECTION FROM HUDSON BAY.

DURING the month of October the Museum received an interesting collection made among the Eskimo tribes of Hudson Bay and adjacent territory by Captain George Comer, who sent a valuable Eskimo collection to the Museum two years ago.

The special interest of the new collection centres in material collected from places that are very difficult of access, and that have not been visited by white men for a very long period. One of the tribes represented is that of Igloolik, a village in the extreme northern part of Fox Channel (see map page 7). This place was visited by Parry in 1822. Since that time only a single white man has visited the region. The other collection is from the tribe inhabiting the most northern part of the American continent northwest of Hudson Bay. This tribe was first visited

by Sir John Ross in 1830. Later the ships commanded by Sir John Franklin were crushed by the ice near the coasts inhabited by this tribe, and the whole crew perished in their territory. Ever since that time the Eskimo of this district have utilized the copper and brass which they found on the lost ships to make their kettles, knives and other implements. In the collection

MAP OF NORTHERN PART OF NORTH AMERICA, SHOWING REGIONS REPRESENTED IN THE ETHNOLOGICAL COLLECTIONS IN THE MUSEUM

made by Captain Comer there are a great many objects which are made of metal obtained from Sir John Franklin's ships.

Perhaps the most interesting of all the specimens in the collection is a shaman's coat, which is figured on page 2. The coat is made of caribou skin, and ornamented with figures cut out of the white skin from the foot of the caribou. It is the only known specimen of a shaman's coat used by an Eskimo, and it is interesting because it resembles in many details the shamans' coats used by the tribes of northeastern Siberia. The circles and the

alternating stripes of black and white fur are very much like the decorations used by the Chukchee and Koryak, and it is very suggestive to find a specimen of this make so far away from the coast of Asia. It may indicate an early and long forgotten connection between the tribes of this region and those of Siberia. Captain Comer received a full explanation of the significance of the various figures on the coat. The two hands signify that no supernatural being can touch the shaman, and the bears at the top of the back of the coat represent the guardian spirits of the owner, while the figure of an infant shown over the hands calls to mind a vision which the shaman had when he received his supernatural power.

Many of the implements and games collected in Igloolik represent new types. They somewhat resemble in form the specimens obtained from the northeastern coast of Baffin Land. Evidently there is a considerable amount of intercourse between Igloolik and that region.

Among the specimens from the region northwest of Hudson Bay are several dresses which are covered with amulets. On a boy's coat we find attachments of bear-teeth and pieces of rabbit-fur and of seal-skin, all of which are intended to secure good luck for the owner. The rabbit-skin is intended to make him tread softly, so that the deer will not hear his approach. The bit of seal-skin will enable him to become a good boatman, and prevent his capsizing in bad weather. Engraved bone implements from this tribe are of interest, also, because they are perhaps the first specimens of engravings obtained from the region, although it has been known for a long time that the Eskimo of Alaska are very expert etchers and engravers. In this the Alaskan Eskimo differ greatly from the eastern Eskimo, who are expert carvers, but who, it would seem, did not do any engraving before the advent of the whites. It is therefore of some interest to find this art fairly well developed as far east as Hudson Bay.

Captain Comer also made a small collection of specimens from Southampton Island. The tribe inhabiting this island is remarkable on account of its primitive character. They still continue to use the bow and arrows with flint points. They make

their knives of bone of the whale. For hunting whales and walrus they use harpoons with flint points, and drags made of whalebone and covered with seal-skin.

The acquisition of this collection supplements the Eskimo collections of the Museum in a most desirable manner. With our previous purchases and expeditions the culture of the Eskimo of Smith Sound, of Baffin Land, of the west coast of Hudson Bay and of Alaska, was represented in the Museum. Captain Comer's collection fills in the gap between the collections from Hudson Bay and those from Baffin Land, and adds a link in the long interval between Hudson Bay and Alaska, which is so difficult of access, and which is not represented in the Museum. During the past year a collection was also received from the Siberian Eskimo, made by Mr. Waldemar Bogoras while he was engaged in researches for the Jesup North Pacific Expedition. It remains now to obtain collections from the southern part of West Greenland and from East Greenland, from Labrador, and from the regions east of Mackenzie River, in order to represent adequately the whole culture of the Eskimo tribes.

THE MUSEUM'S FIN-BACK WHALE.

ON November 22 a report came that two whales, a very large female and a small male, were stranded on the beach near the Forked River Life-Saving Station, Forked River, N. J. Messrs. Sherwood and Figgins of the Museum were sent at once to investigate the matter and to secure the skeletons and other material of interest. The party found that the female was a magnificent specimen measuring 67 feet 6 inches in length and about 30 feet in circumference. The length of the lower jaw was 14 feet 7 inches, that of the pectoral fin was 3 feet, and the caudal fin, or tail, was 12 feet 4 inches from tip to tip. There were 375 plates of baleen, or "whalebone," on each side of the upper jaw. The skin of the ventral surface formed about eighty longitudinal folds. The color was slatey blue on the back, and white with

some blue markings below. The male was a very young one, only 16 feet long, but closely resembled the female, which evidently was its mother. The fact that the skeleton was incompletely ossified indicated the immature condition of the animal. The hard parts of both whales were obtained and cached for future attention.

These individuals belong to the group of whalebone whales and to the genus *Balænoptera*. Probably they are specimens of *B. musculus*, which is the most common whale of temperate climates. Whalers know this species as the "Finner" or "Fin-back," and do not prize it, on account of the small amount of blubber and the small size of the whalebone which it carries. In the large specimen here mentioned the longest plate of whalebone was only 2 feet long, while in the Right Whale it is often 12 feet in length.

Whales, probably, are descendants of terrestrial mammals which have assumed an aquatic existence, a change of life which has been accompanied by remarkable modifications in the structure of the animals. Some organs have become highly specialized, while others have completely degenerated. Teeth, which are a characteristic feature of land mammals, are entirely lacking in the adult Fin-back, their place being taken in part by the whalebone. The forelimbs have ceased to be appendages of locomotion and have become mainly balancing organs. They resemble the pectoral fins of fish, although they still retain the structural plan of the mammalian forelimb. The hindlimbs and pelvis have disappeared entirely externally, and internally are represented only by two nodules of bone. The whale, in fact, is one of the best examples known illustrating the influence of environment in the modification of structure.

RECENT PUBLICATIONS.

The following articles of Vol. XVI (1902) of the Museum "Bulletin" have been issued since April 23, completing the volume:

Nomenclatorial Notes on American Mammals. By J. A. Allen. 10 pages.

American Eocene Primates, and the Supposed Rodent Family Mixodectidæ. By Henry Fairfield Osborn. 46 pages, 40 text illustrations.

List of Mammals Collected in Alaska by the Andrew J. Stone Expedition of 1901. By J. A. Allen. 16 pages.

List of Birds Collected in Alaska by the Andrew J. Stone Expedition of 1901. By Frank M. Chapman. 18 pages.

A Preliminary Study of the South American Opossums of the Genus *Didelphis*. By J. A. Allen. 32 pages.

New Canidæ from the Miocene of Colorado. By W. D. Matthew. 10 pages, 4 text illustrations.

A Horned Rodent from the Colorado Miocene. With a Revision of the Mylagauli, Beavers and Hares of the American Tertiary. By W. D. Matthew. 20 pages, 17 text illustrations.

The Skull of *Hypisodus*, the Smallest of the Artiodactyla, with a Revision of the Hypertragulidæ. By W. D. Matthew. 6 pages, 4 text illustrations.

List of the Pleistocene Fauna from Hay Springs, Nebraska. By W. D. Matthew. 6 pages.

Boring Algæ as Agents in the Disintegration of Corals. By J. E. Duerden. 10 pages, 1 plate.

Martinique and St. Vincent; a Preliminary Report upon the Eruptions of 1902. By Edmund Otis Hovey. 40 pages, 1 text illustration, 18 plates.

Mammal Names Proposed by Oken in his "Lehrbuch der Zoologie." By J. A. Allen. 8 pages.

Descriptions of Some Larvæ of the Genus *Catocala*. By William Beutenmüller. 14 pages.

The Earlier Stages of Some Moths. By William Beutenmüller. 4 pages, 1 plate.

Notice of a New Genus of Marine Algæ, Fossil in the Niagara Shale. By R. P. Whitfield. 2 pages, 1 plate.

On Jurassic Stratigraphy on the West Side of the Black Hills. —Second Paper on American Jurassic Stratigraphy. By F. B. Loomis. 8 pages, 2 plates.

A New Caribou from Ellesmere Land. By J. A. Allen. 4 pages, 2 text illustrations.

Descriptive Catalogue of the Noctuidæ Found within Fifty Miles of New York City. Part II. By William Beutenmüller. 46 pages, 4 plates.

The Hair Seals (Family Phocidæ) of the North Pacific and Bering Sea. By J. A. Allen. 41 pages, 10 text illustrations.

Other publications issued during the year have been:

Bulletin, Vol. XV, part I. The Eskimo of Baffin Land and Hudson Bay. By Franz Boas. 370 pages, 172 text illustrations, 4 plates.

Bulletin, Vol. XVII, part II. Maidu Myths. By Roland B. Dixon. 86 pages.

Bulletin, Vol. XVIII, part I. The Arapaho. By Alfred L. Kroeber. 150 pages, 46 text illustrations, 31 plates.

Memoirs, Vol. VI. The Night Chant, a Navaho Ceremony. By Washington Matthews. 332 pages, 19 text illustrations, 8 plates. Quarto.

LECTURES AND ANNOUNCEMENTS

Prof. A. S. Bickmore announces the following programme for the second course of lectures to teachers, each lecture being given twice on successive Saturday mornings. It is hoped that the supply of coal will allow the course to begin on January 24 and continue uninterruptedly.

London — Westminster Abbey and Oxford University.

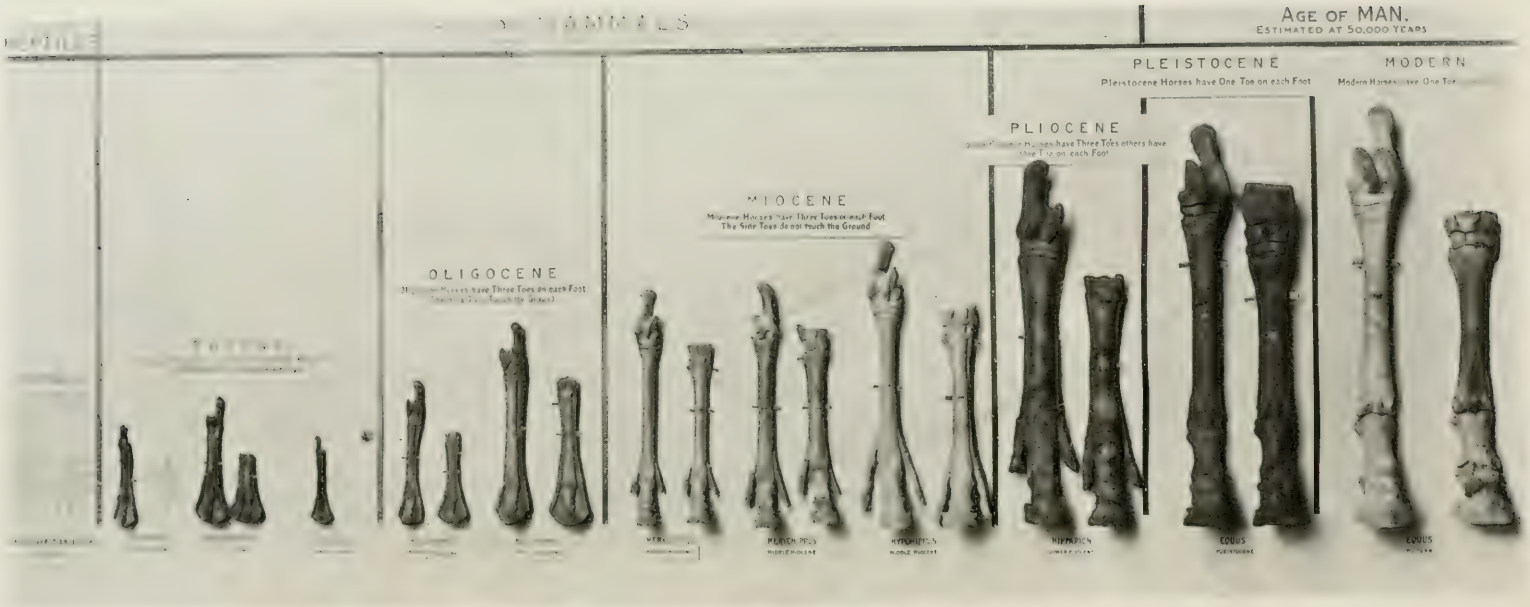
Edinburgh and Glasgow.

The Adirondack Park.

Our Native Trees.

The Board of Education lectures on Tuesday and Saturday evenings will be resumed about the middle of the month.

Regular meetings of the New York Academy of Sciences will be held on Monday evenings throughout the month, and meetings of the New York Linnæan Society and the New York Entomological Society will be held on the usual Tuesday evenings.



EVOLUTION OF THE HORSE. FEET
Series on exhibition in the American Museum

ILLUSTRATIONS OF EVOLUTION AMONG FOSSIL MAMMALS.

A.— The Horse.

By W. D. Matthew, Ph.D.,
Associate Curator, Department of Vertebrate Palæontology.

As a domestic animal the Horse is to be found almost everywhere that man can live. He is spread all over the world — from torrid to arctic climates, in all the continents, in remote oceanic islands — he is completely cosmopolitan. But as a wild animal the Horse is at present limited to the Old World, and is found there only in the open arid or desert plains of Central Asia and Africa. There are two species in Asia, the Asiatic Wild Ass (*Equus hemionus*), and the little known Przewalsky's Horse (*E. przewalskii*), while in Africa there are the African Wild Ass (*E. asinus*) and the several species of Zebra (*E. zebra, E. burchelli, E. quagga*). In the Americas and Australia there are no true wild horses, the mustangs and broncos of the Western Plains and South America being *feral* (domesticated animals run wild) and descended from the horses brought over from Europe by the early white settlers. When the Spaniards first explored the New World they found no horses on either continent. The Indians were quite unfamiliar with them and at first regarded the strange animal which the newcomers rode with wonder and terror, like that of the ancient Romans when Pyrrhus and his Greeks brought elephants—"the huge earth-shaking beast"[1]—to fight against them.

The Horse is distinguished from all other animals now living by the fact that he has but one toe on each foot. Comparison with other animals shows that this toe is the third or middle digit of the foot. The hoof corresponds to the nail of a man or the claw of a dog or cat, and is broadened out to afford a firm, strong support on which the whole weight of the animal rests. Behind the "cannon-bone" of the foot are two slender little

[1] Macaulay —"The Battle of Lake Regillus."

bones, one on each side, called *splint-bones*. These represent the second and fourth digits of other animals, but they do not show on the surface, and there is nothing like a separate toe. So that the horse may be said to be an animal that walks on its middle finger-nail, all the other fingers having disappeared.

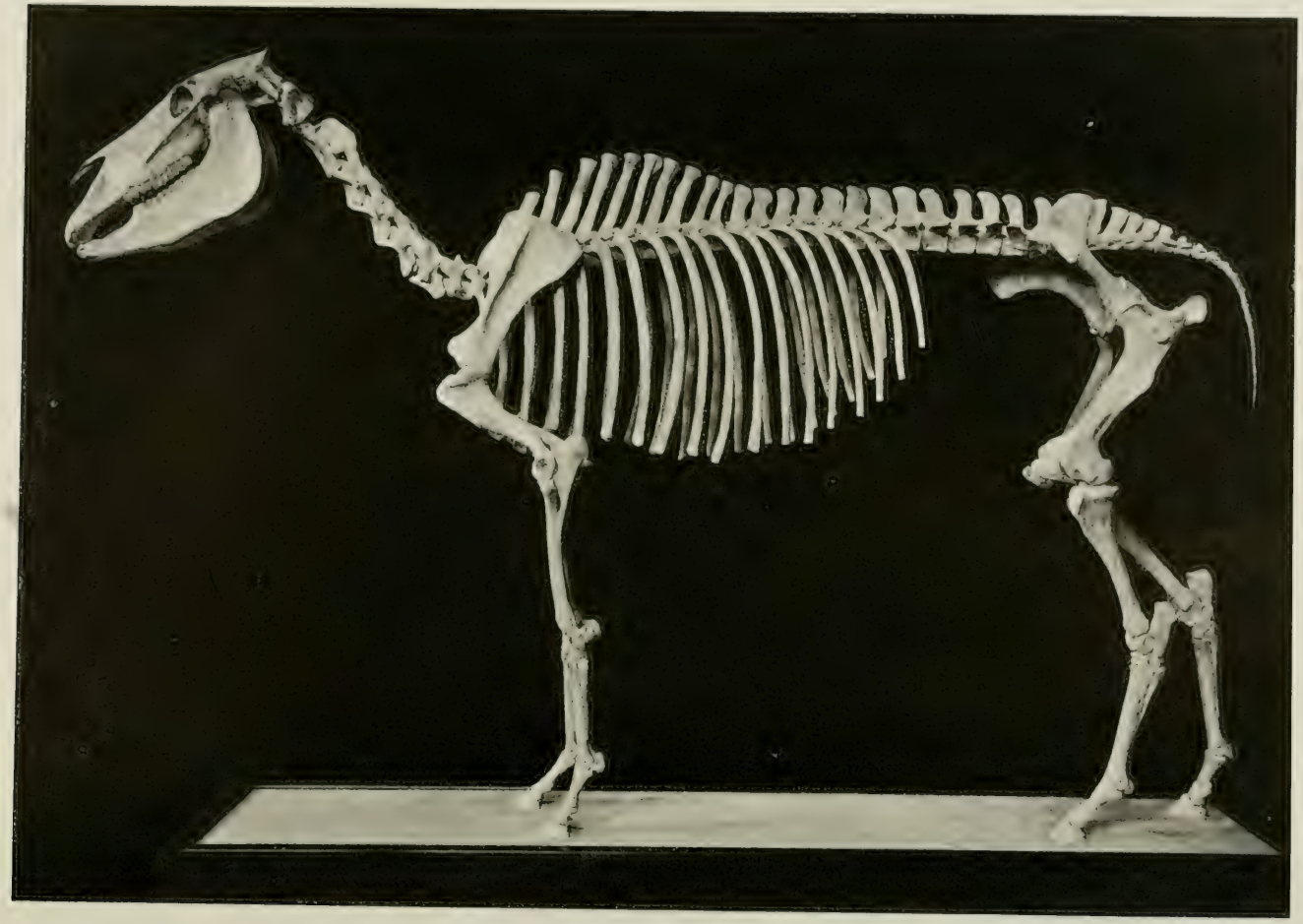
The teeth of the horse are almost equally peculiar. The molars are long, square prisms which grow up from the gums as fast as they wear off on the crowns. Their grinding surface exhibits a peculiar and complicated pattern of edges of hard enamel between which are softer spaces composed of dentine and of a material called "cement," much like the dentine in quality but formed in a different way. The dentine is formed on the inside surfaces of the enamel while the tooth is still within the jaw-bone; the cement is deposited on the outside surfaces of the enamel after the tooth has broken through the jaw-bone and before it appears above the gums.

Various other peculiarities distinguish the Horse from most other animals; some of these are shared by other hoofed animals. The two long bones of the fore-arm (*radius* and *ulna*) are separate in the greater number of animals, but in the Horse, and in many other hoofed animals they are consolidated into a single bone. The same consolidation is seen in the bones of the lower leg (*tibia* and *fibula*). The lengthening of the foot and stepping on the end of the toe raises the heel in the Horse, as in many other animals, to a considerable height above the ground, where it forms the hock joint, bending backward, as the knee bends forward. In these as in various other ways the legs of the horse are especially fitted for swift running over hard and level ground, just as its teeth are for grinding the wiry grasses which grow on the open plain.

The Zebra and the Ass have the same peculiar structure of teeth and feet as the Domestic Horse, and differ only in the color of the skin, proportions of various parts of the body etc.

Fossil Horses of the Age of Man.

The Age of Man, or Quaternary Period, is the last and by far the shortest of the great divisions of geological time. It includes the Great Ice Age or Glacial epoch (Pleistocene), when heavy



SKELETON OF "EQUUS SCOTTI," FROM THE LOWER PLEISTOCENE OF TEXAS
Mounted in the American Museum

continental glaciers covered the northern parts of Europe and North America, and the Recent Epoch, of more moderate climate during which civilization has arisen.

In the early part of the Quaternary Period, wild species of Horse were to be found on every continent except Australia. Remains of these true native horses have been found buried in strata of this age in all parts of the United States, in Alaska, in Mexico, in Ecuador, Brazil and Argentina, as well as in Europe, Asia and Africa. All these horses were much like the living species and most of them are included in the genus *Equus*. A complete skeleton of one of them (*Equus scotti*) found by the American Museum expedition of 1899 in Northern Texas, is mounted in the large wall-case. The difference between it and the Domestic Horse (see framed diagram of modern horse skeleton) is chiefly in proportions, the skull shorter with deeper jaws, the legs rather short and feet small in proportion to the body. In these characters this fossil horse resembles an overgrown zebra rather than a domestic horse. We know nothing of its coloring. It may have been striped, and in this case would have been very zebra-like; but there are some reasons for believing that it was not prominently striped. The bones are petrified, brittle and heavy, the animal matter of the bone having entirely disappeared and having been partly replaced by mineral matter. They are not much changed in color, however, and are so perfectly preserved that they look almost like recent bone.

All the remains of these native horses which have been found in America have been petrified more or less completely; this means that they have been buried for many thousands of years, for petrifaction is an exceedingly slow process.[1] It serves as an easy method of distinguishing them from bones of the Domestic Horse, found buried in the earth. These cannot in any case have been buried for more than four or five centuries, and have not had time to petrify.

Remains of these fossil horses from various parts of the United States are shown in the counter-case. One very rich

[1] The so-called petrifaction which occurs in some hot springs, coating objects dipped into them with a white, stony coat of lime is not true petrifaction. In true petrifaction the substance of the bone is replaced particle by particle with mineral matter.

locality is on the Niobrara river in Nebraska, another in central Oregon. Many separate teeth and bones have been found in the phosphate mines near Charlestown, S. C.; other specimens have come from central Florida, from southern Texas, Arizona, Kansas, Louisiana and even from Alaska. They are, in fact, so often found in deposits of rivers and lakes of the latest geological epoch (the Pleistocene) that the formation in the western United States has received the name of Equus Beds.

In South America, in strata of the Pleistocene Epoch, there occurs, besides several extinct species of the genus *Equus*, the *Hippidium*, a peculiar kind of Horse characterized by very short legs and feet, and some peculiarities about the muzzle and the grinding teeth. The legs were hardly as long as those of a cow, while the head was as large as that of a racehorse or other small breed of the Domestic Horse.

All these horses became extinct, both in North and South America. Why, we do not know. It may have been that they were unable to stand the cold of the winters, probably longer continued and much more severe during the Ice Age than now. It is very probable that man — the early tribes of prehistoric hunters — played a large part in extinguishing the race. The competition with the bison and the antelope, which had recently migrated to America — may have made it more difficult than formerly for the American Horse to get a living. Or, finally, some unknown disease or prolonged season of drought may have exterminated the race. Whatever the cause, the Horse had disappeared from the New World when the white man invaded it (unless a few individuals still lingered on the remote plains of South America), and in his place the bison had come and spread over the prairies of the North.

In Central Asia, two wild races persist to the present day; others were domesticated by man in the earliest times, and their use in Chaldæa and Egypt for draught and riding is depicted in the ancient mural paintings. In Africa the larger species became extinct in prehistoric times, as in America, but the smaller zebras still survive in the southern part of the continent (one species, the Quagga, abundant fifty years ago, is now probably extinct), and the African Wild Ass is found in the fauna of the northern

THE EVOLUTION OF THE HORSE.

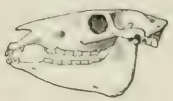
		Formations in Western United States and Characteristic Type of Horse in Each	Fore Foot	Hind Foot	Teeth
Quaternary or Age of Man	Recent				
	Pleistocene	SHERIDAN			
Tertiary or Age of Mammals	Pliocene	BLANCO			
	Miocene	LOUP FORK			
	Oligocene	JOHN DAY WHITE RIVER			
	Eocene	UINTA BRIDGER WIND RIVER WASATCH			
Age of Reptiles	Cretaceous Jurassic Triassic	PUERCO AND TORREJON			

Equus

One Toe
Splints of 2nd and 4th digits

One Toe
Splints of 2nd and 4th digits

Long-Crowned, Cement-covered



Protohippus

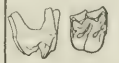
Three Toes
Side toes not touching the ground

Three Toes
Side toes not touching the ground

Mesohippus

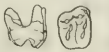
Three Toes
Side toes touching the ground; splint of 5th digit

Three Toes
Side toes touching the ground



Protorohippus

Four Toes



Short-Crowned, without Cement

Hyracotherium (Eohippus)

Four Toes
Splint of 1st digit

Three Toes
Splint of 5th digit.

Hypothetical Ancestors with Five Toes on Each Foot and Teeth like those of Monkeys etc.

J. Morris S. 1900

part. The Wild Horse of prehistoric Europe, a small race, short-legged and shaggy-haired, was domesticated by man, a fact that is known from the rude drawings scratched on bone or ivory by men of the Neolithic or Polished Stone Age. But the Domestic Horse now in use is derived chiefly from the Asiatic race, although it is probable that in some breeds there is a considerable strain of this shaggy, short-legged European race, and it is possible also that African races may have been domesticated and to some extent mixed with the Asiatic species. The domesticated Ass is a descendant of the African species.

The Evolution of the Horse.

The history of the evolution of the Horse through the Tertiary period or Age of Mammals affords the best known illustration in existence of the doctrine of evolution by means of natural selection and the adaptation of a race of animals to its environment. The ancestry of this family has been traced back to nearly the beginning of the Tertiary without a single important break. During this long period of time, estimated at nearly three millions of years, these animals passed through important changes in all parts of the body, but especially in the teeth and feet, adapting them more and more perfectly to their particular environment, namely the open plains of a great plateau region with their scanty stunted herbage, which is the natural habitat of the Horse.

In the series of ancestors of the Horse we can trace every step in the evolution of those marked peculiarities of teeth and feet which distinguish the modern Horse from an ancestor which so little suggests a horse that, when its remains were first found forty years ago, the animal was named by the great palæontologist Richard Owen, the *Hyracotherium* or "Coney-like Beast." Its relation to the Horse was not at that time suspected by Professor Owen, and was recognized by scientific men only when several of the intermediate stages between it and its modern descendant had been discovered. On the other hand this first ancestor of the Horse line is very difficult to distinguish from the contemporary ancestors of tapirs and rhinoceroses, and indicates how all the

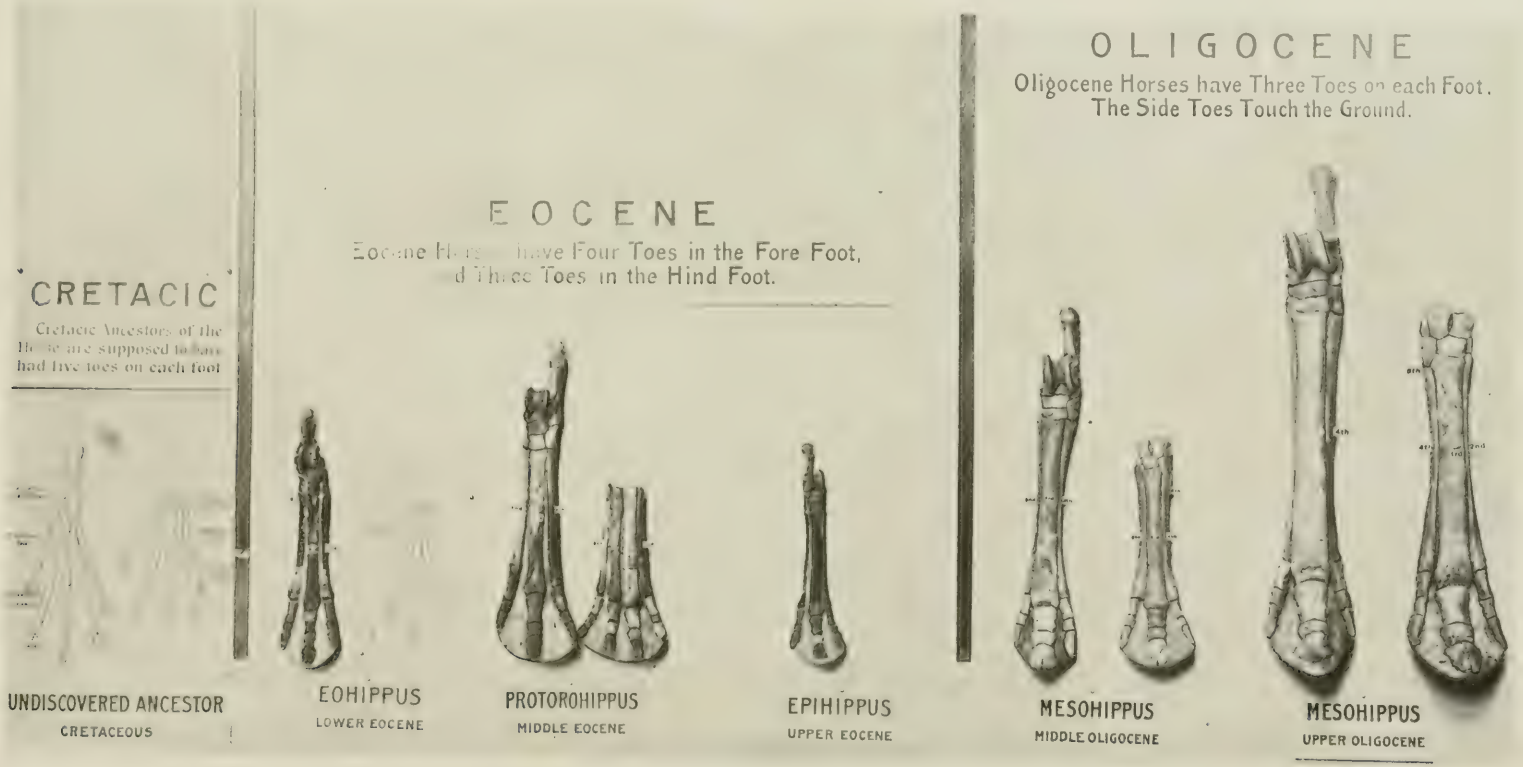
modern quadrupeds have diverged from a single type, each becoming adapted to the needs of its especial mode of life.

The earliest known ancestors of the Horse were small animals not larger than the domestic cat, with four complete toes on each forefoot and three on each hindfoot. There is reason to believe that the still more ancient ancestors of this and all other mammals had five toes on each foot. In the forefoot of the earliest known stage we find a splint-bone or small, slender rudiment representing the missing first digit or thumb, which no longer appears on the surface of the foot, while in the hindfoot there is a similar rudiment representing the outer or fifth digit, but no trace is left of the innermost or first digit. The proportions of the skull, the short neck and arched back and the limbs of moderate length, were very little horse-like; recalling, on the contrary, some modern carnivorous animals, especially the civets (*Viverridæ*). The teeth were short-crowned and covered with low rounded knobs of enamel, suggesting those of monkeys and of pigs or other omnivorous animals, but not at all like the long-crowned complicated grinders of the Horse.

Commencing with the *Hyracotherium*, twelve stages have been recognized from as many successive formations, showing the gradual evolution of the race into its modern form, and each stage is characteristic of its particular geological horizon. Some of the stages have been found in several parts of the world, but by far the most complete and best known series comes from the Tertiary Badlands of the Western States. Besides the main line of descent which led into the modern horses, asses and zebras, there were several collateral branches which have left no descendants. Of some stages all parts of the skeleton have been found; of others only the jaws, or jaws and feet, are known. We can mention only the more important stages.

1 and 2.[1] **Hyracotherium** and **Eohippus.** LOWER EOCENE. The *Hyracotherium* is the most primitive stage known, but only the skull has been found, so that it has not been determined exactly what the feet were like. The teeth display six rounded knobs or cusps on the upper molars and four on the lower ones,

[1] These numbers refer to the stages in the direct line of descent of the modern Horse; see frontispiece.



EARLY STAGES IN THE EVOLUTION OF THE FEET
From the series on exhibition in the American Museum

and these are just beginning to show signs of fusing into cross-crests. The premolar teeth have only one main cusp, except the third and fourth premolars (next the molars) in each jaw, which have two and three, respectively. The only specimens which have been found were in the London Clay or Lower Eocene of England and are preserved in the British Museum.

The *Eohippus* is much better known. It comes from the Lower Eocene of Wyoming and New Mexico, and is very like the *Hy-*

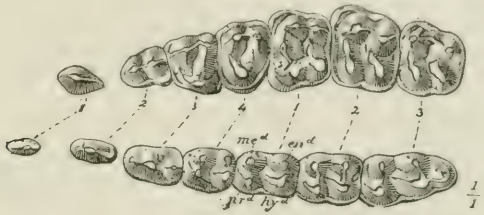


FIG. 1.—UPPER AND LOWER TEETH OF "EOHIPPUS," FROM THE LOWER EOCENE OF WYOMING. NATURAL SIZE

racotherium except that the molar teeth have the cusps more clearly fusing into cross-crests, and the last premolar is beginning to look like one of the true molars. The forefoot of this animal has four complete toes and the splint of a fifth. The hindfoot has three complete toes and the splint of another. A specimen of the hindfoot is shown in the series in the A-case and many incomplete specimens, skulls, jaws etc., of several species in the counter-case.

3 and 4. **Protorohippus** and **Orohippus.** MIDDLE EOCENE. In these animals the splint of the first digit in the forefoot and the splint of the fifth digit of the hindfoot have disappeared, but there are still four complete toes in the fore- and three in the hind-foot. The crests on the molars are a little clearer and the last premolar has become almost like the molars, while the next to the last premolar is beginning to become so. A skeleton of *Protorohippus* is mounted in the wall-case. It shows an animal of the size of a small dog, and proportioned much like the breed known as the *whippet*, of which a skeleton has been placed near by for comparison with the *Protorohippus* skeleton. The *Protoro-hippus* was found by Dr. J. L. Wortman in 1880 in the Wind

River Badlands of Wyoming, and was described by Professor Cope and others under the name of the "Four-Toed Horse."

Of *Orohippus* we have only parts of jaws and teeth. A specimen of the forefoot is exhibited in the Museum of Yale University.

5. **Epihippus.** Upper Eocene. Of this stage of the evolution of the Horse only incomplete specimens have been found. The molar teeth have the once round cusps almost completely converted into crescents and crests, while another tooth of the premolar series has become like the molars. The toes are still four in the forefoot and three in the hindfoot, but the central toe in each foot is becoming much larger than the side toes, a feature which may be seen in the hindfoot shown in the series in the case. (This species happens to be somewhat smaller than those found in the Middle Eocene stage, but no doubt there were others of larger size living at the same time.)

Palæotherium and *Paloplotherium* of the Upper Eocene of Europe form a side branch of the Horse line. They were very abundant in Europe, but have not been found in the New World. On each foot they had three toes of nearly equal size, and the teeth show a rather peculiar pattern. One of these animals was thought by Professor Huxley to be a direct ancestor of the Horse, but it now is considered to be merely a collateral relative. Some species of *Palæotherium* were of large size, equal to a tapir. They were first described in the year 1804 by the celebrated Baron Cuvier from remains found in the gypsum quarries of Montmartre, Paris. A large series of skulls, jaws, foot-bones etc., from the Upper Eocene of France, is exhibited in one of the counter-cases.

6 and 7. **Mesohippus.** Oligocene (*White River Formation*). In this stage there are three toes on each foot, a splint representing the fifth digit of the forefoot of the Eocene ancestors. The middle toe is now much larger than the side toes, which bear very little of the weight of the animal. Three of the premolars have now become entirely like the molar teeth, the crests on the crown are completely formed, and the outside crest in the upper molars has taken the shape of two crescents. In the Middle Oligocene is found *Mesohippus bairdi* about the size of a coyote,

LATER STAGES IN THE EVOLUTION OF THE FEET

From the series on exhibition in the American Museum

while in the Upper Oligocene occurs *Mesohippus intermedius* as large as a sheep. Of both these animals all parts of the skeleton are known, and a good series of skulls, feet, jaws, palates etc. is

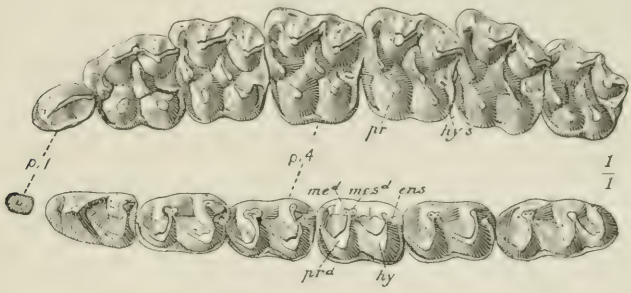


FIG. 2.—UPPER AND LOWER TEETH OF "MESOHIPPUS BAIRDI," FROM THE MIDDLE OLIGOCENE OF SOUTH DAKOTA. NATURAL SIZE

exhibited in the counter-case, besides the specimens shown in the series of feet and in the series of skulls.

8. **Anchitherium.** LOWER MIOCENE. This stage has been found both in Europe and in America. It is much like its predecessor, but is larger and has the crests of the teeth somewhat higher and more complete. It probably is not in the direct line of descent of the horses, but is on a side branch. A palate, jaws, teeth and foot-bones are exhibited here.

9. **Parahippus** and **Hypohippus.** MIDDLE MIOCENE. In *Parahippus* the tooth-crests are much higher, and the transverse ridges on the upper molars are beginning to change shape so as to become a second pair of crescents inside the outer pair. *Hypohippus* is off the direct line of descent; its teeth are like those of *Anchitherium*, by which name it has been generally called, but the animal was much larger, equalling a Shetland pony in size. A complete skeleton of the *Hypohippus* is shown in wall-case 15, and illustrates very well the general characters of the Three-Toed Horses, although it is not in the direct line. This specimen was found near Pawnee Buttes, Colorado, in 1901 by Barnum Brown, of the Whitney expedition. Other incomplete specimens of *Hypohippus*, *Parahippus* and *Merychippus* are shown in the counter-case, and casts of the feet and skull in the evolution series in A-Case 49. It may be observed that in the forefoot of

Hypohippus small rudiments still remain representing the first and fifth digits, but there is no splint of the fifth, as in *Mesohippus*. The second and fourth digits still touch the ground, though lightly.

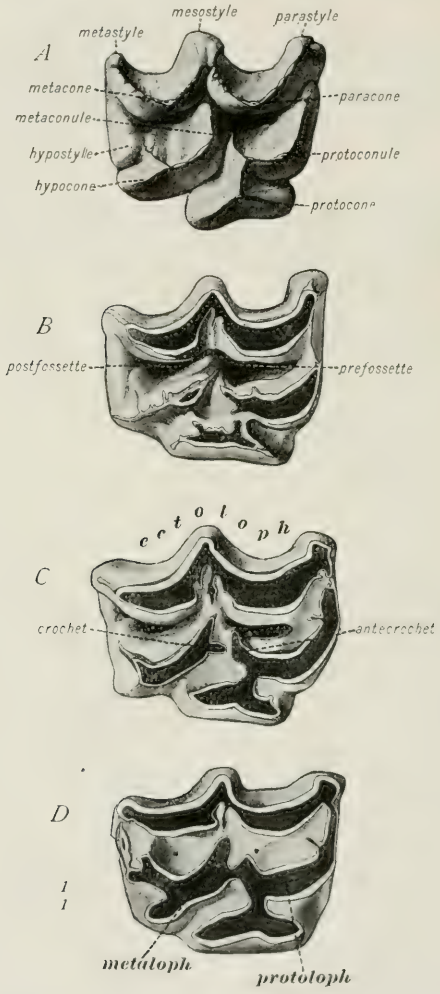
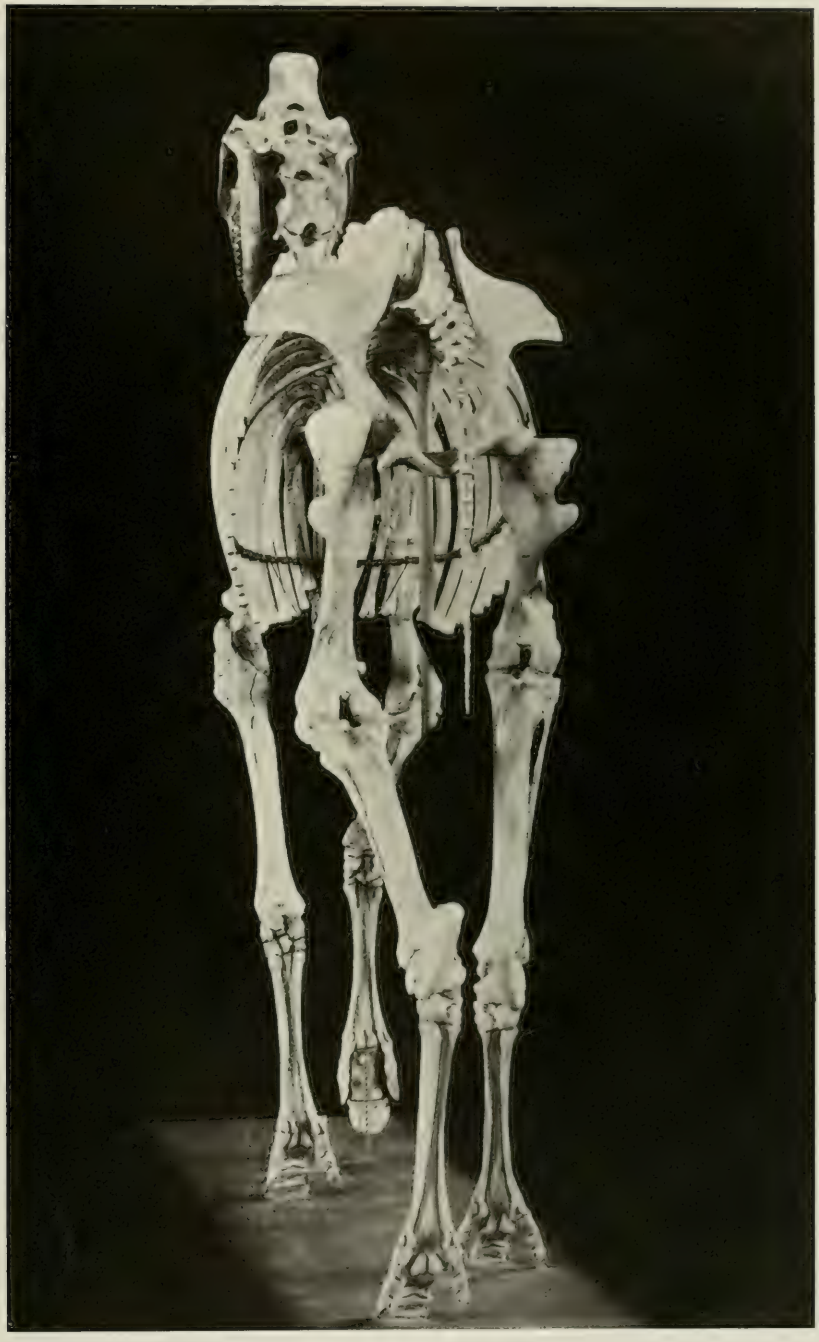


FIG. 3.—UPPER MOLAR OF MODERN HORSE, SHOWING EARLY STAGES OF WEAR OF THE TOOTH. CROWN VIEW. NATURAL SIZE

The feet of *Parahippus* were much like those of *Hypohippus*, but the side toes were smaller.

10 and 11. **Protohippus** and **Pliohippus.** MIDDLE and



THREE-TOED HORSE "HYPOHIPPUS," FROM THE MIDDLE MIOCENE OF COLORADO

Rear view of skeleton, showing small side toes

Upper Miocene. In this stage the crowns of the upper molars have become much longer, the two pairs of crescents on the upper molars are complete, with two half-separated cusps within the inner pair. And the valleys between the crests have become filled with cement, so that with the wear of the teeth the edges of hard enamel are backed inside by dentine and outside by cement. In this way the surface of the tooth has a series of enamel ridges always projecting a little above the grinding surface, because the softer material on each side wears down into hollows, yet never breaking off, because they are braced so thoroughly on each side. This is a very efficient instrument for grinding hard grasses. In *Protohippus* and *Pliohippus*, especially in the former, the crowns of the teeth are by no means as long as in the modern horses; they must therefore wear more slowly or wear out at an earlier age.

The feet in these two genera have but one toe touching the ground. The side toes (second and fourth digits) are complete, but much more slender than in the earlier stages and are apparently useless, as they cannot reach the ground. In some species of *Pliohippus* they have almost disappeared. The forefoot of *Protohippus* still retains tiny nodules of bone at the back of the "wrist" (sometimes improperly called in the Horse the "knee-joint"), which are the remains of the first and fifth digits.

Hipparion. Pliocene. This genus, probably also a side branch of the genealogical tree of the horse family, is much like *Protohippus*, but larger and with more complication about the tooth pattern. It is common in the European Pliocene beds and has been found in America also. The feet are still three-toed, the side toes as large as those of the older *Protohippus*.

12. **Equus.** Pleistocene and Recent. In this stage, that of the modern Horse, the side toes have entirely disappeared and are represented by splints on the fore- and hind-foot. No trace remains on the forefoot of the little nodules which in *Protohippus* represented the first and fifth digits. The crowns of the teeth are much longer than in the last stage, and of the two half-separated inner columns on the upper molars, one has disappeared, the other has increased in size and changed in form. The skull has lengthened and the animal is much larger.

Hippidium. Pleistocene. South America. The feet are like those of *Equus*, except that they were short and stout. The teeth are like those of *Pliohippus*, from which it is supposed to be descended. The skull is large and long with very long slender nasal bones. Casts of the skull and limbs presented by the Museo Nacional of Buenos Ayres, Argentine Republic, are exhibited here.

Meaning of the Change in Feet and Teeth.

Along with the disappearance of the side toes in the evolution of the Horse there is a considerable increase in the proportionate length of the limbs, and especially of the lower part of the leg and foot. The surfaces of the joints, at first more or less of the ball-and-socket kind, which allows free motion of the limb in all directions, become keeled and grooved like a pulley-wheel, permitting free motion forward and backward, but limiting the motion in all other directions and increasing considerably the strength of the joint. By this means the foot is made more efficient for locomotion over a smooth regular surface, but less so for traveling over very rough ground, and it becomes of little use for striking or grasping or the varied purposes for which the feet of polydactyl animals are used.

The increased length in the lower leg and foot increases the length of the stride without decreasing its quickness. The heavy muscles of the leg are chiefly in the upper part, and to increase the length of the lower part changes the centre of gravity of the limb very little. Consequently the leg swings to and fro from the socket nearly as fast as before, since in an ordinary step the action of the leg is like that of a pendulum and the speed of the swing is regulated by the distance of the centre of gravity from the point of attachment, as that of a pendulum is by the height of the bob. To increase the length of lower leg and foot therefore gives the animal greater speed; but it puts an increased strain on the ankles and toe-joints, and these must be strengthened correspondingly by converting them from ball-and-socket joints to "ginglymoid" or pulley joints. Additional strength, likewise at the expense of flexibility, is obtained by the consolidation of the two bones of the fore-arm (*ulna* and

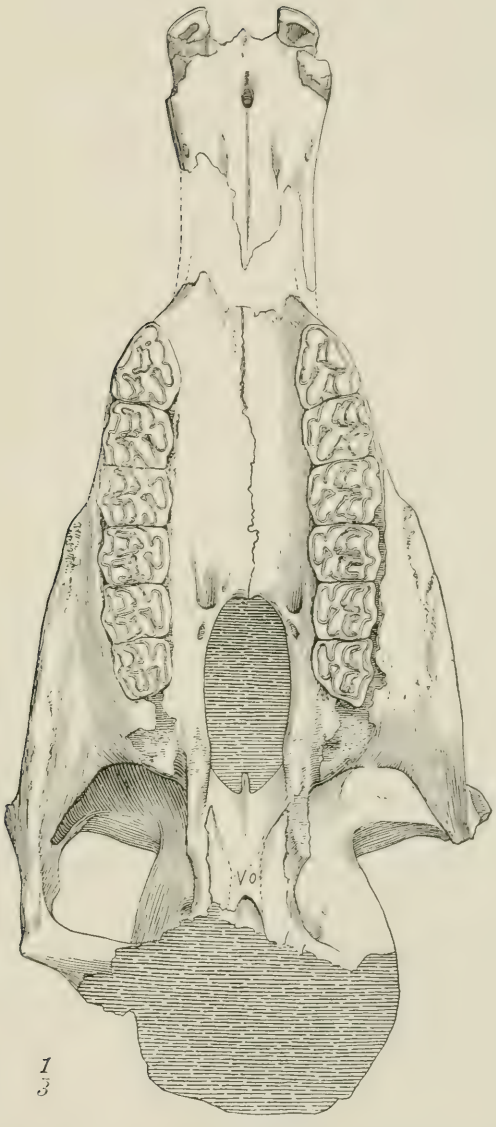


FIG. 4.—PALATE AND UPPER TEETH OF "EQUUS INTERMEDIUS," FROM THE LOWER PLEISTOCENE OF TEXAS. ONE-THIRD NATURAL SIZE

radius) and of the leg (*tibia* and *fibula*) into one, the shaft of the smaller bone practically disappearing, while its ends become fused solidly to its larger neighbor.

The increase in length of limb renders it necessary for the grazing animal that the head and neck should increase in length in order to enable the mouth to reach the ground. An example of these changes is the modern Horse, in which we find the neck and head much elongated when compared with the little *Hyracotherium* and this elongation has taken place *pari passu* with the elongation of the legs. The reduction and disappearance of the side toes and the concentration of the step on the single central toe serve likewise to increase the speed over smooth ground. The soft yielding surface of the polydactyl foot is able to accommodate itself to a rough irregular surface, but on smooth ground the yielding step entails a certain loss of speed. A somewhat similar case is seen in the pneumatic tire of a bicycle; a "soft" tire accommodates itself to a rough road and makes easier riding, but a "hard" tire is faster, especially on a smooth road. Similarly, the hard, firm step from the single toe allows of more speed over a smooth surface, although it compels the animal to pick its way slowly and with care on rough, irregular ground.

The change in the character of the teeth from "brachydont" or short-crowned to "hypsodont" or long-crowned enables the animal to subsist on the hard, comparatively innutritious grasses of the dry plains, which require much more thorough mastication before they can be of any use as food than do the softer green foods of the swamps and forests.

All these changes in the evolution of the Horse are adaptations to a life in a region of the level, smooth and open grassy plains which are now its natural habitat. At first the race was better fitted for a forest life, but it has become more and more completely adapted to live and compete with its enemies or rivals under the conditions which prevail in the high dry plains of the interior of the great continents. The great increase in size, which has occurred in almost all races of animals whose evolution we can trace, is dependent on abundance of food. A large animal, as may be shown on ordinary principles of mechanics, requires more food in proportion to its size than does a

small one, in order to keep up a proper amount of activity. On the other hand a large animal is better able than a small one to defend itself against its enemies and rivals. Consequently, as long as food is abundant, the larger animals have the advantage over their smaller brethren, and by the laws of natural selection the race tends to become continually larger until a limit is reached, when sufficient food becomes difficult to obtain, the

RESTORATION OF THE FOUR-TOED HORSE

Oldest known Ancestor of the Modern Horse; only 16 inches high

Photo from original watercolor by C. R. Knight, based on mounted skeleton in American Museum

animal being compelled to devote nearly all its time to getting enough to eat.

Cause of the Evolution.

The evolution of the Horse, adapting it to live on the dry plains, probably went hand in hand with the evolution of the plains themselves. At the commencement of the Age of Mam-

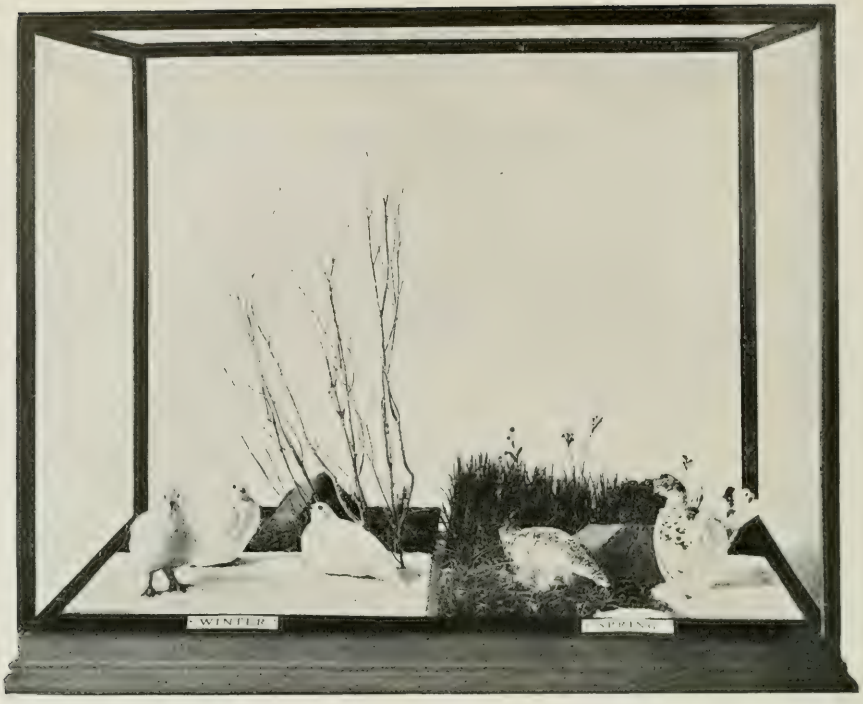
mals the western part of the North American continent was by no means as high above sea-level as now. Great parts of it had but recently emerged and the Gulf of Mexico still stretched far up the valley of the Mississippi. The climate at that time was probably very moist, warm and tropical, as is shown by the tropical forest trees, found fossil even as far as Greenland. Such a climate, with the low elevation of the land, would favor the growth of dense forests all over the country, and to such conditions of life the animals of the beginning of the mammalian period must have been adapted. During the Tertiary the continent was steadily rising above the ocean-level, and at the same time other influences were at work to make the climate continually colder and drier. The coming on of a cold, dry climate restricted and thinned the forests and caused the appearance and extension of open, grassy plains. The ancient forest inhabitants were forced either to retreat and disappear with the forests, or to adapt themselves to the new conditions of life. The ancestors of the Horse, following the latter course, changed with the changing conditions, and the race became finally as we see it to-day, one of the most highly specialized of animals in its adaptation to its peculiar environment. At the end of the Age of Mammals the continents stood at a higher elevation than at present, and there was a broad land connection between Asia and North America, as well as those now existing. At this time the Horse became cosmopolitan, and inhabited the plains of all the great continents, excepting Australia.

It is a question whether the direct ancestry of the modern Horse is to be searched for in Western America or in the little known interior plains of Eastern Asia. It is also unknown why the various species which inhabited North and South America and Europe during the early part of the Age of Man should have become extinct, while those of Asia (Horse and Wild Ass) and of Africa (Wild Ass and Zebra) still survive. Man, since his appearance, has played an important part in the extermination of the larger animals; but there is nothing to show how far he is responsible for the disappearance of the native American species of horse.

Parallel Evolution in Other Races.

It is interesting to observe that while the evolution of the Horse was progressing during the Tertiary period in North America another group of hoofed animals, the *Litopterna*, now extinct, in South America evolved a race adapted to the broad plains of Argentina and Patagonia and singularly like the Horse in many ways (see exhibit in A-case in centre of hall). These animals likewise lost the lateral toes one after another, and concentrated the step on the central toe; they also changed the form of the joint-surfaces from ball-and-socket to pulley-wheel joints; they also lengthened the limbs and the neck; and they also lengthened the teeth, and complicated their pattern. Unlike the true Horse, they did not form cement on the tooth, so that it was by no means so efficient a grinder. This group of animals native to South America became totally extinct, and were succeeded by the horses, immigrants from North America, which in their turn became extinct before the appearance of civilized man.

Many of the contemporaries of the Horse in the northern hemisphere were likewise lengthening the limbs, lightening and strengthening the feet, elongating the tooth-crowns to adapt themselves to the changing conditions around them, but none paralleled the Horse Evolution quite so closely as did the pseudo-horses of South America. But the camels in America, the deer, antelope, sheep and cattle in the Old World progressed on much the same lines of evolution, although their adaptation was not to just the same conditions of life.



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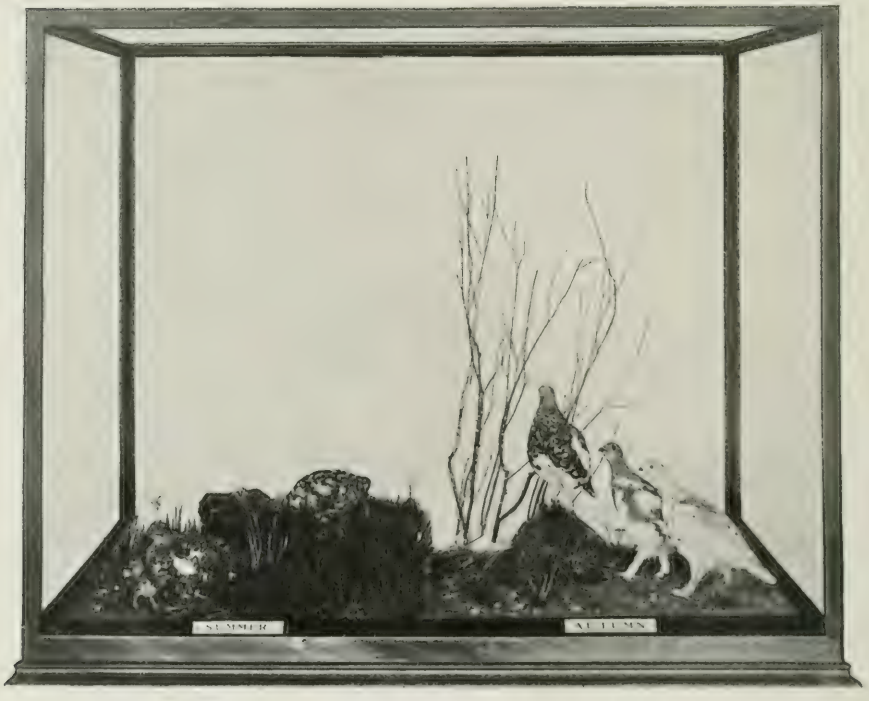

3 4

THE PTARMIGAN GROUP

The American Museum Journal

VOL. III. FEBRUARY, 1903 No. 2.

THE Guide Leaflet sent out with this number of the JOURNAL describes in popular language the members of the family of SPHINGIDÆ, or "Hawk-Moths," which are to be found in the vicinity of New York City. The arrangement of the species in the Leaflet corresponds with that of the specimens in the cases, and the Leaflet, therefore, forms a convenient guide to the collection. More detailed descriptions of these beautiful and interesting moths will be found in Mr. Beutenmüller's article on the Sphingidæ which was published in Volume VII of the "Bulletin" of the Museum.

THE PTARMIGAN GROUP.

A GROUP, or rather an assemblage of four groups in one case, of the Ptarmigan was placed on exhibition in the Bird Hall on the main floor of the Museum in January. The four small groups together illustrate one of the most interesting cases of seasonal change known among birds. The group has been provided for through the liberality of J. D. Cadwalader, Esq.

In the summer the birds are brown and black, in the autumn, grayish, and in the winter, white. These changes are accomplished by molt and feather-growth, not by change in the color of existing feathers, as has been stated by some writers, and are designed to protect the birds from their enemies by keeping them in harmony with their surroundings, and thereby rendering them inconspicuous. It will be observed that the white winter birds (group No. 1) molt in the spring (group No. 2), and pass directly into summer plumage (group No. 3).

It is a law among birds that the adults undergo a complete molt immediately after the cares of the nesting season are over, and that there shall be no further feather-growth until the following spring or summer. The Ptarmigan, however, obey only the first portion of this law. In response to what are evidently imperative physiological demands they molt directly after the nesting; but if they were to pass at once into their winter plumage, as is customary among birds, they would become pure white before snowfall and hence be made conspicuous by the plumage which is designed to protect them.

To bridge over the period between the normal, postnuptial molt and the season of snow, an additional plumage is assumed on the exposed parts of the body (group No. 4). This is worn only during late summer and early fall and is immediately succeeded by the winter plumage. The changes in the nature of the birds' surroundings are, therefore, as it were, imitated by the birds, which consequently are always difficult to see in the treeless regions they inhabit.

NEWS NOTES.

THREE new fossil specimens of interest have been placed on exhibition in the hall of Vertebrate Palæontology. One is the skull of a Duck-billed Dinosaur, an immense biped reptile nearly forty feet in length. The skull is three feet ten inches long and has a broad flat beak like that of the spoon-bill duck. This skull is part of a nearly complete skeleton which is being prepared for exhibition. The second specimen is the skull of a Mammoth of the largest size, with tusks measuring thirteen feet in length around the outside of their curvatures, probably the longest pair ever found. This specimen came from southern Texas, and is of a larger species than the Siberian mammoth. The third consists of the fore and hind limbs and a cast of the skull of the *Diprotodon*, an extinct Australian mammal of gigantic size. Like all the other Australian mammals it belonged to the Marsupial or Pouched division.

SCENES FROM THE PTARMIGAN GROUP

In the April, 1902, issue of the Journal reference was made to the valuable specimens received by the Museum from the New York Zoölogical Park, through the kindness of the Director, Dr. William T. Hornaday. From April to December, 1902, inclusive, the accessions from this source have included 2 Orangs, 2 Baboons, 1 Gelada Baboon, 1 Barbary Ape, 12 Monkeys of several species, 8 Lemurs of several species, 1 Clouded Leopard, 1 Blue Fox, 2 Sea Lions, 1 Sun Bear, 1 Himalayan Bear, 2 Binturongs, 2 European Badgers, 1 Sand Badger, 1 Mountain Sheep, 1 Spanish Ibex, 1 Barbary Sheep, 4 American Bisons, 1 Musk-Ox, 1 Pronghorn Antelope, 1 Virginia Deer, 1 Florida Deer, 1 Mexican Deer, 1 Mule Deer, 2 Armadillos and various other mammals and a few birds. Some of these are available for mounting and for skeletons and the others add very valuable material to the study collection, including a number of species not previously represented in our collections.

Dr. E. O. Hovey of the Geological Department has started for the West Indies to make further studies upon the volcanic islands. He will continue the work which he began there last summer directly after the May eruptions, and, after noting the changes produced in St. Vincent and Martinique by the eruptions subsequent to the time of his leaving the latter island in July, he will visit the other volcanic islands of the chain of the Lesser Antilles for the purpose of comparing their condition with that of the recently devastated areas.

During the past month the Messrs. Hyde have had a second group of Navajo Indians at the Museum, the first having visited the Museum and the East during the winter of 1901–1902. Both groups of Navajos were brought East for the purpose of exhibiting here the native methods of blanket weaving used in the Southwest and to familiarize teachers and students with the primitive work of these nomads. The Navajo loom of the present day is practically a duplication of the loom that was used by the ancient Cliff-Dwellers hundreds of years before the Conquest. Centuries of contact with civilization have not changed the loom to any appreciable extent and at the present time the

only implements used in blanket work that they have borrowed from their white neighbors are the shears with which they shear their sheep and the cards used in preparing the wool for spinning.

A COLLECTION of personal ornaments from the State of Oaxaca, Mexico, pertaining to the Mixtecan-Zapotecan civilization, has been presented to the Museum by the Duke of Loubat.

This beautiful collection of the "gems" of ancient Mexico contains more than three hundred objects of gold, copper, jadeite of different hues from dark emerald green to white slightly tinged with green, turquoise, rock crystal, amethyst, agate, chalcedony, serpentine, obsidian and shell. Noteworthy pieces are a splendid miniature bell, made to represent the head of a monkey, a string of gold beads, two tiny beads of gold made in filigree, a frog carved out of rock crystal, a long perforated bead with spiral design, made out of obsidian, and a parrot carved from a vivid green pebble of jadeite. All of these specimens were found in ancient graves, and together with our already extensive collection of similar objects, form a unique exhibit in the Mexican Hall of the Museum.

A LARGE relief map of the city and harbor of New York, which was given by the firm of Johnson and Higgins to the New York Chamber of Commerce, and presented by the New York Chamber of Commerce to the American Museum of Natural History, has been placed on exhibition on the ground floor near the elevators. The elevations above, and the depressions below the level of mean low water, have been greatly magnified as compared with the horizontal scale. Although this gives a distorted appearance to the general surface, it facilitates the comparison of the various altitudes, and the relative drainage areas of the several river systems.

PROF. J. C. MERRIAM of the Department of Geology of the University of California spent about two weeks of the month of January at the Museum studying the collection of fossil mammals from the John Day beds of Miocene Tertiary age from the Far West, and identifying Oregon material from the California University collections by comparison with Professor Cope's type specimens.

LECTURES.

Prof. Albert S. Bickmore's second course of lectures for the season to teachers will be given Saturday mornings at half after ten o'clock according to the following programme.

January 24 and 31.—"Oxford, Westminster and the Coronation."

February 7 and 14.—"Glasgow and Edinburgh."

February 21 and 28.—"The Adirondack Park."

March 7 and 14.—"American Forests."

The second course of lectures for the season offered by the City Board of Education in coöperation with the Museum was begun Tuesday, January 6. It consists of eight lectures on Tuesday evenings on European geography and eight lectures on Saturday evenings on electricity and magnetism. The geographical lectures are illustrated by stereopticon views, while the lectures on electricity are illustrated by means of experiments. The programme of the course is as follows:

Tuesday, January 6.—Thomas Edward Potterton, "London: The World's Metropolis."

Saturday, January 10.—Prof. E. R. von Nardroff, "Magnetism and Diamagnetism." Illustrated.

Tuesday, January 13.—Prof. Henry Zick, "Berlin and Military Life in Germany."

Saturday, January 17.—Prof. E. R. von Nardroff, "Electricity at Rest."

Tuesday, January 20.—Ernest R. Holmes, "Paris."

Saturday, January 24.—Prof. E. R. von Nardroff, "Electricity in Motion: Its Chemical Effects."

Tuesday, January 27.—W. Torrence Stuchell, "Switzerland."

Saturday, January 31.—Prof. E. R. von Nardroff, "Electricity in Motion: Its Heating Effects."

Tuesday, February 3.—Dr. Augusta J. Chapin, "Venice."

Saturday, February 7.—Prof. E. R. von Nardroff, "Electricity in Motion: Its Magnetic Effects."

Tuesday, February 10.—Dr. Augusta J. Chapin, "Naples and Pompeii."

Saturday, February 14.—Prof. E. R. von Nardroff, "Electricity in Motion: Its Inductive Effects."

Tuesday, February 17.—William Freeland, "Spain."

Saturday, February 21.—Prof. E. R. von Nardroff, "Cathode Rays, X Rays, Radium Rays."

Tuesday, February 24.—R. S. Dawson, "La Belle France."

Saturday, February 28.—Prof. E. R. von Nardroff, "Electromagnetic Waves: Their Properties and Uses."

MEETINGS OF SOCIETIES.

The New York Academy of Sciences will hold its regular meetings on Monday evenings throughout February, according to the following schedule. The meetings are held in the small Assembly Hall of the Museum and the public is invited to attend.

February 2.—Business meeting and section of Astronomy, Physics and Chemistry.

February 9.—Section of Biology.

February 16.—Section of Geology and Mineralogy.

February 23.—Section of Anthropology and Psychology.

The meetings of the New York Entomological Society will be held in the Assembly Hall on February 3 and 17, and those of the Linnæan Society of New York in the same hall on February 10 and 24.

The regular meeting of the New York Mineralogical Club will be held in conjunction with the Section of Geology and Mineralogy of the New York Academy of Sciences, Monday evening, February 16.

On Saturday afternoon, January 24, at three o'clock, Prof. John B. Smith, of the State Agricultural Experiment Station at New Brunswick, N. J., gave an illustrated lecture on "Mosquitoes, their Life History and Habits." The lecture was arranged for in coöperation with the New York Entomological Society.

AMERICAN MUSEUM OF NATURAL HISTORY

The Hawk-Moths of the Vicinity of New York City

BY

William Beutenmüller

Curator of Entomology

SUPPLEMENT TO AMERICAN MUSEUM JOURNAL
VOL. III, No. 2, FEBRUARY, 1903
Guide Leaflet No. 10

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The Hawk-Moths of the Vicinity of New York City

A Guide Leaflet to the Collection on Exhibition
in the
American Museum of Natural History

By

WILLIAM BEUTENMÜLLER
Curator of Entomology

PUBLISHED BY THE MUSEUM
AS SUPPLEMENT TO THE AMERICAN MUSEUM JOURNAL
Vol. III, No. 2, February, 1903
Guide Leaflet No. 10

THE HAWK-MOTHS OF THE VICINITY OF NEW YORK CITY.

By William Beutenmüller,
Curator of the Department of Entomology.

Family *Sphingidæ*.

The members of the family of Sphingidæ are commonly called "Hawk-Moths" on account of their powerful and rapid flight and their beak-like proboscis. Some of the species are also called Hummingbird Moths, owing to their peculiar habit of hovering like a hummingbird over flowers while drawing up nectar with their long proboscis. Some species fly during mid-day in the hot sunshine, while others fly late in the afternoon and at night.

The moths have long, narrow fore wings, with an oblique, excavated or scolloped outer margin. The hind wings are much shorter, with the outer margin entire, the anal angle usually produced and the apex rounded or pointed.

The head is usually clothed with smooth scales, or has a tuft between the antennæ. The eyes are hemispherical, and as a rule lashed with hairs in front above. The proboscis is well developed in most of the species, and is nearly as long as or longer than the body. When not in use the organ is curled up like a watch-spring, between the palpi. The antennæ are fusiform, ciliate in the male and simple in the female, and with the tip more or less bent into a hook. In some species the antennæ are club-shaped, with a few short, bristle-like hairs at the tip.

The thorax is well developed, either with the vestiture smooth, or with the posterior portion with erect scales, or with the anterior portion with an elevated tuft.

The body usually is long and graceful, with the segments gradually tapering. Some species are provided with a more or less entire fan-like tuft at the end of the body.

The eggs are green, smooth, oval or oblong oval. They are usually laid singly, on the under sides of a leaf, and the young

caterpillar hatches in from five to seven days after the eggs have been deposited. The caterpillars as a rule shed their skins or moult five times before reaching maturity. The mature caterpillars are smooth, or sometimes more or less granulated over the surface. The last segment is provided with a horn, or marked with a tubercle or polished eye-like spot instead. Most of the Hawk-Moth caterpillars are marked with seven lateral, oblique stripes. After reaching maturity, and when ready to transform, they descend from their food-plants to the ground. Most forms burrow into the soil, where they construct cells, in which they change to pupæ, but some species form their pupæ on the surface of the ground, in a loose, web-like cocoon between leaves. The pupæ are almost always chestnut brown, elongate, with the tongue-case either buried or detached and resembling the handle of a pitcher.

KEY TO THE HAWK-MOTHS.

Wings partly transparent	Group A.
Wings wholly opaque	" B.
With yellow markings on body	Section 1.
With yellow markings on hind wings	" 2.
With green and pink markings on wings	" 3.
With green markings on wings, without pink	" 4.
With pink markings on wings, without green	" 5.
With brown markings, without pink, green or yellow	" 6.
With gray or blackish brown markings, without pink, yellow or green	" 7.

Group A.—WINGS PARTLY TRANSPARENT.

Underside of thorax pale yellow without a line on each side.
Outer border of fore wings toothed within . . . . *Hemaris thysbe.*
Like *thysbe*, but larger . . . . var. *floridensis.*
Outer border of fore wings not toothed within . . . var. *ruficaudis.*
Underside of thorax pale yellow with a red-brown line on each side.
Outer border of fore wings even within . . . . . *Hemaris gracilis.*

Underside of thorax pale yellow with a black line on each side.
Outer border of fore wings broad; toothed within.
Hemaris axillaris.
Like *axillaris*, but with outer border of fore wings not toothed within.....var. *marginalis.*
Outer border of fore wings narrow.....*Hemaris diffinis.*

Group B.—WINGS WHOLLY OPAQUE.

Section 1.—With yellow markings on body.

Abdomen with large yellow spots on each side.
Fore wings light gray..*Phlegethontius quinquimaculatus.*
" " dark gray.....*Phlegethontius carolina.*
" " sooty brown with white lines.
Phlegethontius rusticus.
Abdomen with two yellow transverse lines.
Fore wings rich brown with darker velvety brown band.....*Amphion nessus.*

Section 2.—With yellow markings on hind wings.

Fore wings chocolate brown with darker markings.
Hind wings yellow at base.....*Sphecodina abbotii.*
Fore wings rich brown with lilac lines.
Hind wings yellow, with an eye-like spot.
Smerinthus myops.
Fore wings almost uniform orange brown with lilac streaks.
Hind wings uniform orange with an eye-like spot.
Smerinthus astylus.
Fore wings ochre brown with oblique lines.
Hind wings black with a row of yellow spots.
Theretra tersa.
Fore wings brown, veins finely marked with black.
Hind wings ochre yellow, with a black outer band.
Sphinx lucitiosa.

Section 3.—With green and pink markings on wings.

Fore wings olive green with a broad buff band from base to tip: veins partly marked with white.

Hind wings pale green at base, marked with black, pink outwardly. . . . . *Philampelus vitis.*

Fore wings similar to *vitis* but darker.

Hind wings not pink outwardly, except at anal angle. *Philampelus linnei.*

SECTION 4.—**With green markings on wings, without pink.**

Fore wings an almost uniform green.

Hind wings marked with blue. . . . . *Argeus labruscæ.*

Fore wings green with whitish and pinkish lines.

Hind wings rusty brown with gray outer margin. *Ampelophaga versicolor.*

Fore wings olive gray with more or less distinct olive green band and shades.

Hind wings rusty brown with a gray patch at anal angle. . . . . *Ampelophaga myron.*

Fore wings pale olive with rich dark green shades and patches.

Hind wings pale green with large black patches. *Philampelus pandorus.*

SECTION 5.—**With pink markings on wings, without green.**

Fore wings gray, with darker markings.

Body with a row of rose-colored spots on each side. *Phlegethontius cingulatus.*

Fore wings pale chocolate brown with rich velvety brown patches.

Hind wings pink, outwardly chocolate brown. *Philampelus achemon.*

Fore wings dark olive brown with a buff-colored oblique band from base to tip; veins marked with white.

Hind wings black with a broad pink band. *Deilephila lineata.*

Fore wings olive brown with an oblique buff band; veins not marked with white.

Hind wings with a pinkish band. *Deilephila galii*, form *intermedia.*

Fore wings gray with a pinkish tinge, and deep brown markings.

Hind wings red at base with an eye-like spot.
Smerinthus geminatus.

Fore wings rich brown with a rosy tint.
Hind wings rose color with an eye-like spot.
Smerinthus excæcatus.

Fore wings gray with an olive gray median band.
Hind wings marked with claret red.
Amorpha modesta.

SECTION 6.—**With brown markings, without pink, green or yellow.**

Fore wings rusty brown, basal half paler.
Hind wings rusty brown.....*Ampelophaga chœrilus.*

Fore wings chocolate brown with darker shades outwardly.
Hind wings almost uniform chocolate brown.
Enyo lugubris.

Fore wings sooty brown with two rows of white spots and bands not running across the wing.
Hind wing sooty black.
Abdomen with a white band.....*Aëllopos tantalus.*

Fore wings sooty brown with white lines and shades.
Hind wings blackish brown with incomplete white bands.....*Dolba hylæus.*

Fore wings light and dark chestnut brown in form of streaks.
Hind wings brownish white with a central and an outer black band .....*Sphinx kalmiæ.*

Fore wings ashen brown with black dashes.
Hind wings black with two dirty white bands.
Sphinx eremitus.

Fore wings coffee brown, pale along the outer and costal parts and with black streaks between the veins.
Hind wings brown with an ill-defined band in middle.....*Ceratomia amyntor.*

Fore wings sepia brown with lighter scales, and with black dashes near the tip.
Hind wings uniform sepia brown...*Ceratomia catalpæ.*

Fore wings mouse gray with a toothed transverse line and two black dashes.

Hind wings uniform warm brown, tipped with white.
Lapara coniferarum.

Fore wings with a double-toothed transverse line and two angulated lines.
Hind wings as in *coniferarum*....*Lapara bombycoides.*

Fore wings light gray, sometimes streaked with brown.
Hind wings rusty brown with darker outer border.
Dilophonota ello.

Fore wings dark brown with ash-gray markings.
Hind wings dull rusty brown.....*Deidamia inscripta.*

Fore wings light ochre brown, sometimes marked with darker brown.
Hind wings similar, with two narrow lines.
Cressonia juglandis.

SECTION 7.—**With gray or blackish brown markings, without pink, yellow or green.**

Hind wings with a white band.

Fore wings ash gray with four black streaks between the veins.
Thorax gray with two black lines...*Sphinx chersis.*

Fore wings dirty gray with black dashes.
Thorax dull gray with two obscure black lines; sides whitish.....*Sphinx canadensis.*

Fore wings sooty black, grayish in the middle.
Thorax brown black; side gray....*Sphinx gordius.*

Fore wings deep sooty blackish brown, pale gray along the costal region.
Thorax deep brownish black, sides pale grayish.
Sphinx drupiferarum.

Hind wings without white band.

Fore wings gray with many dark transverse wavy lines.
Thorax grayish bordered with black.
Ceratomia undulosa.

Fore wings light gray with a prominent oblique black dash.....*Chlænogramma jasminearum.*

Fore wings gray streaked with black and with a white dot near the middle.....*Sphinx plebeius.*

1. *Hemaris thysbe.* 2. *H.*, var. *ruficaudis.*
3. *H.*, var. *floridensis.*

Very common, especially in gardens. Double-brooded. It flies in the day in the sunshine during the latter part of May and early June and again late in July and early in August. The variety *ruficaudis* (Fig. 2) is less common than *thysbe*. A second variety, *floridensis*, is very rare in this vicinity, but is common southward. The species ranges from Labrador to Florida and westward to the Mississippi. The caterpillar feeds on different kinds of *Viburnum*. Forms a pupa on the ground in a loose cocoon.

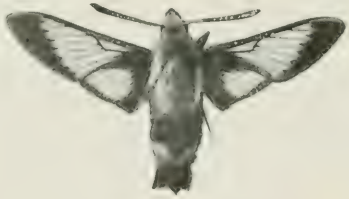
4. *Hemaris gracilis.*

Very rare in this neighborhood. Double-brooded, appearing

in May and June and again in July and August. It is closely allied to *H. thysbe* var. *ruficaudis*, but differs therefrom by its smaller size and by having a red stripe on each side of the thorax beneath, and three rows of white spots on the under side of the abdomen. It flies during the day in the sunshine.

5. *Hemaris diffinis.*

In the immediate vicinity of New York this species is very rare. It is found from Canada to Florida, and westward to Missouri and Iowa. In certain localities it is rather common. Found during the latter part of May and early in June and again during July and August. It flies during the day in the sunshine. The caterpillar feeds on snowberry (*Symphoricarpus*), feverwort (*Triosteum perfoliatum*) and bush-honeysuckle. Forms a pupa on the ground in a loose cocoon.



6. *Hemaris axillaris.*

Very rare in this vicinity, but more abundant in the Western States. It is found from New York to Texas. In general appearance it resembles *H. diffinis*, but the outer border of the fore wing is broader, and is more or less toothed inwardly, while in *diffinis* it is even. The body is longer. The moth flies during the day in the sunshine. The caterpillar feeds on different kinds of honeysuckle. Forms a pupa in a loose cocoon on the ground.

7. *Aëllopos tantalus.*

This southern species is found occasionally in this vicinity. It may be known by its sooty black color and the white third segment of the body. It flies during the daytime in the hottest sunshine. The early stages are unknown.

8. *Enyo lugubris.*

A southern species very rarely found in this vicinity. It is common in the Southern States, Mexico and the West Indies.

9. *Amphion nessus.*

Rich dark brown with darker velvety markings and two

yellow transverse bands on the abdomen. It is found late in May and early in June and again in August. It flies during the hottest sunshine and also in the evening. Found from Canada to Florida, and westward to Iowa. The caterpillar feeds on grape, willow-herb (*Epilobium*) and Virginia creeper. Forms a pupa in a loose cocoon on the ground.

10. *Sphecodina abbotii.*

Very common in this vicinity. The moth appears in May and June and again during the latter part of July and early in August. Found from Canada and Eastern States westward to Iowa. The caterpillar feeds on grape and Virginia creeper. It enters the ground to pupate.

11. *Deidamia inscripta.*

Not common in this vicinity. The moth makes its appearance during the latter part of May and the first days in June. Found from Canada to Virginia and westward to the Mississippi valley. The caterpillar feeds on grape and Virginia creeper. Enters the ground to pupate.

12. *Deilephila lineata.*

This species is found in the United States, Canada and Cuba. In this vicinity common everywhere. It flies early in the evening and often in bright daylight. The insect is double-brooded, the first brood appearing during June and July, and the second during the latter part of August and early in September. The caterpillar feeds on purslane, buckwheat, turnip, watermelon, chickweed, dock, evening primrose, apple, currant, grape and gooseberry. Enters the ground to pupate.

13. *Deilephila galii*, form *intermedia.*

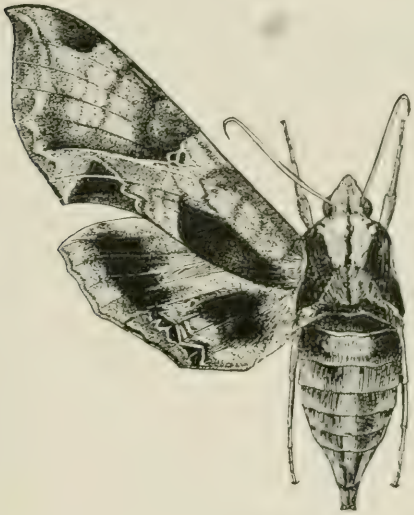
Not common in this vicinity. Found during June and again in August. It is found from Canada to Georgia and westward to California, also found in Europe. The pink median band on the hind wings in the European form (*galii*) is much paler than in the American form (*intermedia*). The caterpillar feeds on purslane, evening primrose and willow-herb (*Epilobium*). Enters the ground to pupate.

14. *Theretra tersa.*

Quite rare in this vicinity, but common in the Southern States, West Indies, Central and South America. It ranges northwardly as far as Canada. It is usually found in flower gardens. The caterpillar feeds on *Bouvardia*, buttonweed (*Spermacoce glabra*) and *Manetta bicolor*. Enters the ground to pupate.

15. *Argeus labruscæ.*

A South American species, occurring northward to Canada. In the north it is an occasional visitor, and is very rarely taken.



16. *Philampelus pandorus.*

Rather common in this vicinity, in gardens and vineyards. It is double-brooded, the first brood appearing during June and early in July, and the second in August. Found in the United States east of the Great Plains and also in Canada. The caterpillar feeds on grape and Virginia creeper. It enters the ground to pupate.

17. *Philampelus achemon.*

This species is double-brooded, the first brood appearing in

June and July, and the second in August. It is found throughout the United States and Canada. The caterpillar feeds on grape and Virginia creeper. Enters the ground to pupate.

18. *Philampelus vitis.*

This species has been recorded from South America, Central America, Cuba, Texas, Florida, and along the Atlantic coast to Massachusetts. It is a southern species, and is very rarely taken in this vicinity. The caterpillar feeds on grape. Enters the ground to pupate.

19. *Philampelus linnei.*

Inhabits South and Central America, Cuba and the Southern

States, and is said to be found northward as far as Massachusetts. It is closely allied to *P. vitis*, but is much darker.

20. *Ampelophaga chœrilus.*

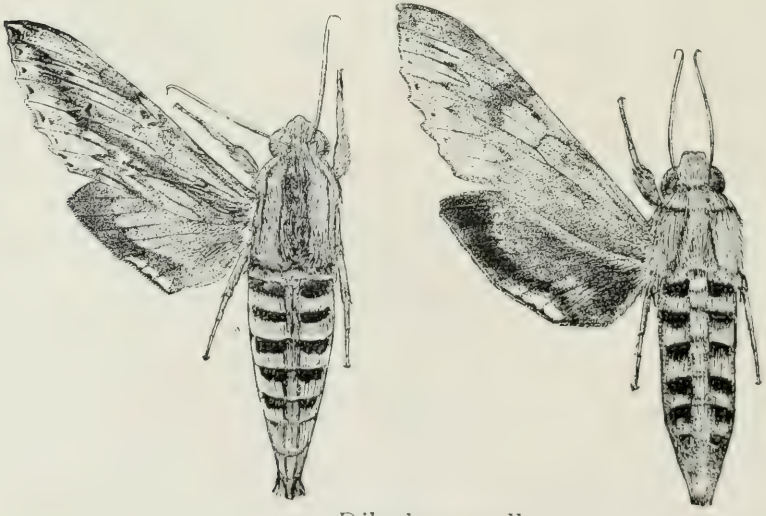
This is a rather common species, and is found in open woods. It may be known readily by its rusty brown color. Found from Canada to Georgia, and westward to Iowa. Double-brooded; on the wing from June to August. The caterpillar feeds on different kinds of *Viburnum*, sour-gum and azalea. It spins a rude cocoon amongst leaves on the surface of the ground.

21. *Ampelophaga myron.*

Rather common in gardens about grapevines. It is double-brooded, the first brood appearing in June and July and the second in August. Found from Canada to Florida, and westward to Missouri and Iowa. The caterpillar feeds on grape. Spins a loose cocoon among leaves on the ground.

22. *Ampelophaga versicolor.*

Quite rare and local in this vicinity. The moth may be known by the bright green coloring on the fore wings, with more or less distinct whitish transverse lines. It is double-brooded, the first brood appearing in June and early in July and the second in August. The caterpillar feeds on button-bush (*Cephalanthus occidentalis*) and swamp-loose-strife (*Nesæa verticillata*). Spins a loose cocoon among leaves on the ground.

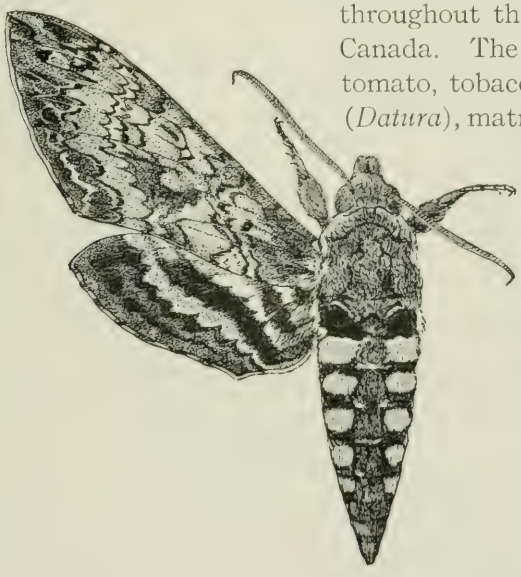


23. *Dilophonota ello.*

A common southern species, but rarely found in this vicinity. It is found from Brazil northward to Canada.

24. *Phlegethontius quinquimaculatus.*

Common and double-brooded in this vicinity. The first brood appear in June, and the second in August. It is found throughout the United States and Canada. The caterpillar feeds on tomato, tobacco, Jamestown-weed (*Datura*), matrimony-vine (*Lycium vulgare*) and ground-cherry (*Physalis viscosa*). The pupa has a long arched tongue-case. Enters the ground to pupate.

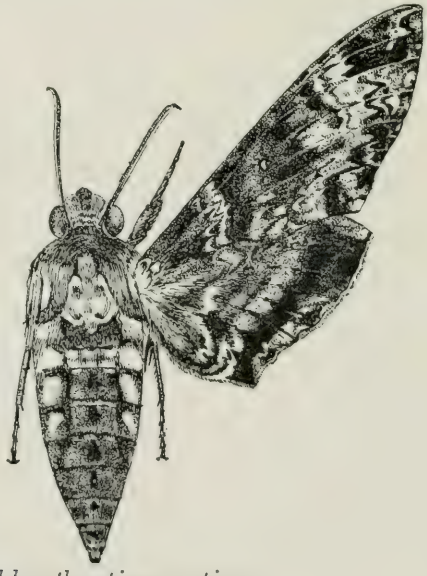


25. *Phlegethontius carolina.*

Found in the United States from the Atlantic to the Pacific, in Canada, Mexico, and the West Indies. It is common and double-brooded in this vicinity. The caterpillar feeds on tomato, tobacco, Jamestown-weed (*Datura*) and matrimony-vine. Enters the ground to pupate.

26. *Phlegethontius cingulatus.*

May be known readily by the rose-red spots on the abdomen. It is found from Canada to Brazil, and to the west coast of our continent, and also in the Hawaiian Islands. Double-brooded; the first brood appears in June and the second in August and September. Enters the ground to pupate.



27. *Phlegethontius rusticus.*

A common southern species rarely taken in this vicinity. Its range of distribution extends from South America northward to

New York; also found in the West Indies. The caterpillar feeds on lilac, privet and fringe-bush (*Chionanthus*). Enters the ground to pupate.

28. *Sphinx drupiferarum.*

Not common in this vicinity. Double-brooded, appearing in June and again early in August. Found from Canada to Florida and westward. The caterpillar feeds on apple, plum and cherry. Enters the ground to pupate.

29. *Sphinx kalmiæ.*

Not common. Double-brooded. It is on the wing in June and again late in July and early in August. Found from Canada

to Georgia and westward to Missouri. The caterpillar feeds on lilac and laurel. Enters the ground to pupate.

30. *Sphinx lucitiosa.*

Very rare in this vicinity. Double-brooded. The moth is on the wing in June and again in August. The caterpillar feeds on willow and poplar. Enters the ground to pupate.

31. *Sphinx gordius.*

Rather common, but not abundant in this vicinity. Double-brooded, appearing in June and July and again in August. It ranges from Canada to Georgia and westward to the Mississippi, and probably farther westward. The caterpillar feeds on apple, pear, ash and wax-myrtle (*Myrica*). Enters the ground to pupate.

32. *Sphinx chersis.*

Double-brooded in this vicinity, appearing in May and June and again late in July and early in August. Found from Canada to Florida, and westward to the Pacific coast. The caterpillar feeds on lilac, ash and privet. Enters the ground to pupate.

33. *Sphinx canadensis.*

Found in Newfoundland, Canada, New England States to New York and Ohio. It is a very rare species, and has not been

found in this vicinity, but it should be searched for. The early stages are unknown.

34. *Sphinx eremitus.*

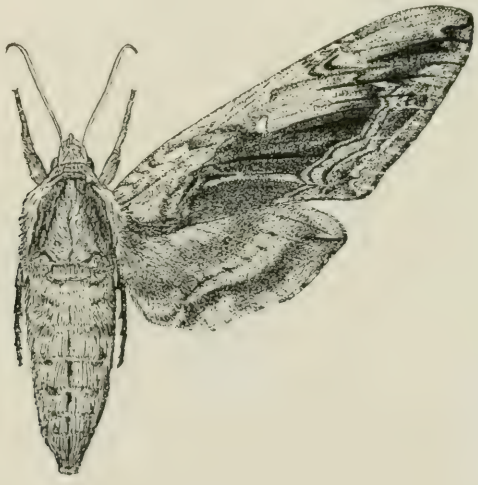
Quite rare and local in this vicinity It is double-brooded. The caterpillar feeds on spear-mint (*Mentha*) and wild bergamot (*Monarda*). Enters the ground to pupate.

35. *Sphinx plebeius.*

Rather common. Usually found in gardens about the trumpet-vine, which is the food of the caterpillar. It is double-brooded, appearing in June and again late in July and early in August. Found from Canada to Florida and westward to the Mississippi. Enters the ground to pupate.

36. *Chlænogramma jasminearum.*

Quite rare and double-brooded. It is found from Canada to Georgia and westward. The caterpillar feeds on ash. Enters the ground to pupate.



37. *Ceratomia amyntor.*

Rather common. Double-brooded. Found from Canada to Virginia, westward to Missouri and Iowa. The caterpillar feeds on elm, birch and linden. Enters the ground to pupate.

38. *Ceratomia undulosa.*

Rather common and double-brooded in this vicinity, the first brood appearing in June and the second in August. It is found from Canada to Carolina, and westward to Iowa. The caterpillar feeds on ash, lilac and privet. Enters the ground to pupate.

39. *Ceratomia catalpæ.*

A southern species gradually extending its range northward. It is exceedingly common in the vicinity of Philadelphia, where

the catalpa trees are sometimes completely defoliated by the caterpillars. The species has made its appearance at Lakehurst, New Jersey, and without doubt before long will be found in this vicinity. The caterpillars are social and live in large colonies, differing in this respect from all other species of Sphingidæ. Enters the ground to pupate.

40. *Dolba hylæus.*

Not common in this vicinity. In general appearance it resembles a miniature *Phlegethontius rusticus* (No. 27). It is found from Canada to Florida and westward to Iowa. The caterpillar feeds on the ink-berry (*Ilex glabra*). Enters the ground to pupate.

41. *Lapara coniferarum.*

Very rare in this vicinity. Found from Canada to Florida, The caterpillar feeds on pine. Enters the ground to pupate.

42. *Lapara bombycoides.*

Very rare in this vicinity. Found from Canada to Florida, and westward to the Mississippi. The caterpillar feeds on pine. Enters the ground to pupate.

43. *Amorpha modesta.*

Rather scarce in this vicinity, but more common in the Northern and Western States. It appears in the latter part of July and August, and may be double-brooded. The caterpillar feeds on willow and poplar. Enters the ground to pupate.

44. *Smerinthus geminatus.*

A common species in this vicinity. It is double-brooded, the first brood appearing in June and July, and the second in August. The moth varies from light to dark gray on the fore wings. Found from Canada to Virginia and westward to Iowa. The caterpillar feeds on willow, poplar, plum, apple, elm, ironwood, hazel, hornbeam, birch, ash etc. Enters the ground to pupate.

45. *Smerinthus excæcatus.*

Common in this neighborhood. Double-brooded, appearing in June and July and again in August. It is found throughout the eastern United States and Canada. The caterpillar feeds on cherry, plum, apple, pear, raspberry, rose, elm, oak, hazel, hornbeam, ironwood, birch, willow, poplar, ash etc. Enters the ground to pupate.

46. *Smerinthus myops.*

Sometimes rather common. It is double-brooded, the first brood appearing in June and July and the second in August. Found from Canada to Florida and westward to the Mississippi. The caterpillar feeds on wild and cultivated cherry. Enters the ground to pupate.

47. *Smerinthus astylus.*

This rare species may be known by its plain orange brown colors and markings. Double-brooded, the first brood appearing late in May and early in June, and the second coming out in July and August. Found from Canada to Pennsylvania, and probably also southward and westward. The caterpillar feeds on huckleberry, dangleberry and *Andromeda ligustrina.* Enters the ground to pupate.

48. *Cressonia juglandis.*

Not rare in this vicinity. Double-brooded. The first brood appears in June and the second in August. The species is subject to considerable variation; some specimens are uniformly pale fawn color or ochraceous, with the transverse lines distinct, while other examples are more or less covered with dark brown so as to almost obscure the ground color and transverse lines. It is found from Canada to Florida and westward to the Mississippi and Texas. The caterpillar feeds on walnut, butternut, hickory and ironwood. Enters the ground to pupate.

THE NEW SPECIMEN OF THE VIRGINIA DEER

The American Museum Journal

VOL. III. MARCH, 1903 NO. 3.

HEREAFTER THE AMERICAN MUSEUM JOURNAL will be issued at quarterly instead of monthly intervals. Each number will contain at least three times as much matter as is now placed in one and will present a review of the Museum's activities during the preceding three months. A guide leaflet monographing some Museum exhibit, similar, therefore, in character, to those already issued, will accompany each number of the JOURNAL.

NEW METHODS IN TAXIDERMY.

UNDER modern methods of preparation animals are not stuffed, but modelled. The preservation of the skin itself falls to the lot of a tanner and hide-dresser who, in the strict sense of the word, is the taxidermist of to-day. The manikin on which the skin is to be placed is first modelled, life-size, in clay, all the anatomy of form being worked out with due detail. This life-size clay image is then cast in plaster and from the plaster molds the final manikin of cheese-cloth, papier-maché, shellac, and fine wire net is made. It is a mere shell, not more than a sixteenth of an inch thick, very light, but strong and durable. It never shrinks or cracks, and is consequently a very distinct advance over a clay manikin which, in drying, materially changes in form with consequent great injury to the skin.

This new method was originated by Mr. C. E. Akeley of the Field Columbian Museum, with whom Mr. J. L. Clark of the American Museum's Department of Preparation has lately been studying. The first animal mounted by Mr. Clark after the Akeley method is the Virginian doe figured in this number of the JOURNAL.

SKULL OF THE IMPERIAL MAMMOTH.

THERE has just been placed on exhibition in the Fossil Mammal Hall of the American Museum of Natural History a superb specimen of the tusks and palate of what may be known as the 'Imperial Mammoth,' described in 1858 by Joseph Leidy as *Elephas imperator*, from a single tooth found in Indiana.

The specimen was discovered in the sands of western Texas many years ago by an amateur collector, and was only recently secured by the American Museum. The upper portions of the skull have been reproduced in plaster, but the entire lower portion of the skull, the large pair of grinding teeth, and the gigantic tusks are complete. The latter fall little short of being the largest elephant tusks thus far described among either living or fossil members of this family. So far as preserved they measure 13 ft. 6 in. from the base of the tusk to the tips, and there is at least a foot broken away from the end of the tip, making the total estimated length 14 ft. 6 in.

On leaving the skull, the tusks (which were undoubtedly used for fighting purposes) in young and middle-aged animals curve downward and outward, then in old animals upward and inward, until the tips almost meet each other. The height of this animal must have been at least 13 ft., 2 ft. higher than that of the famous African elephant "Jumbo," the skeleton of which is also in the Museum.

The single molar or grinding tooth is distinguished from that of the Mammoth of the extreme north, *Elephas primigenius*, and that of the Columbian Mammoth of the middle United States, *Elephas columbi*, by its very large size, and by the comparatively small number of its enamel plates, which are set widely apart and surrounded by broad bands of cement. In the grinders of the northern Mammoth, the enamel plates are extremely numerous and closely appressed, and there is little or no cement.

This specimen of the Imperial Mammoth, therefore, adds greatly to our knowledge; and, together with the giant fore limb, which is placed on exhibition near by, gives an impressive

SKULL AND TUSKS OF THE IMPERIAL MAMMOTH

idea of the enormous size attained by the early Pleistocene or preglacial elephants of this country.

A POSSIBLE AMERICAN KIMBERLEY.

A SERIES of interesting specimens have been received in the Department of Mineralogy from the Kentucky Diamond Mining and Developing Company, which are related to the efforts about to be made by this company in their search for diamonds in Elliott County, eastern Kentucky.

The specimens consist of a large nodule of a green rock known to lithologists as *dunite*, and composed of chrysolite (*peridot*) and pyroxene (*enstatite*) with garnet and an iron mineral (*ilmenite*), with a few specks of mica, the whole greatly changed and converted through most of its mineral texture into serpentine. With this dense rock, taken below the surface, are specimens of the pulverulent, friable and weathered surface rock. This surface rock in weathering discharges the more resistant grains, crystals and fragments of iron oxide and garnet which collect in the stream beds of the region.

A number of specimens, also, of semi-graphitic or coaly character, accompany the peridotitic lumps and nodules which have been taken from beds traversed by the former, where it exists as an eruptive dike rising above the adjacent country.

The speculative basis which is afforded by the presence of this rock in Kentucky is its association with carbon-bearing strata, carboniferous sandstones and shales. It is surmised, after analogies drawn from the diamond region of South Africa, where a similar association seems established, that as the olivine rock in Kentucky is plainly an eruptive rock, in its passage upward through these carbonaceous deposits carbon vapors may have been formed, and their absorption by the liquid magma of the exuding rock resulted in the formation of diamonds.

The "necks" of volcanic rock at Kimberley, S. A., perforate adjacent carbonaceous shales, and the origin of the diamond in that locality has been attributed to their thermal and static action upon carbon vapors, disengaged from these strata.

The question is as yet quite unsettled, but as the "peridotite" of Kentucky *resembles* the rock of South Africa, in which the diamond has been found in such abundance, and the geological relations are quite parallel, in a general way, between it and the county rock, with those developed at Kimberly, the inference seemed plausible, at least, that the diamond would appear, if carefully looked for, in Kentucky also.

There has indeed been some corroboration reported of this suggestion, and at least two diamonds coming from Elliott County, Ky., have been exhibited, though their absolute reference to Kentucky is still in doubt.

Finally, as permitting a greater degree of confidence in this particular, the observation of Friedland may be quoted. He showed that a fused globule of olivine—practically the rock composing the Kentucky dikes—when stirred with a pencil of graphite (carbon), upon cooling, was found to contain microscopic diamond seeds or grains.

The operations of the company will be watched with interest. The specimens from Elliott County and a series from South Africa are exhibited in juxtaposition in Case 25 (north end) in the Mineralogical Hall.—L. P. G.

THE NEW SEA-BIRD GROUP.

ENCOURAGED by the praise which has been so uniformly accorded the "Bird Rock" Group, a companion group has been prepared to represent the sea-bird life of a sandy beach. The addition of a painted background not only increases the instructiveness of this new group by accurately depicting the character of the birds' haunts, but also adds greatly to its beauty and pictorial effect. The attempt to show many birds in flight has also been surprisingly successful, skillful treatment rendering the birds' means of support practically invisible.

The locality represented is Cobb's Island, Virginia, a shell-strewn, sandy islet seven miles long and about the same distance from the mainland. This was formerly one of the most remark-

CENTRAL PORTION OF THE GROUP OF BEACH-BREEDING BIRDS OF COBB'S ISLAND

able breeding-places for birds on our Southern coast; but when a demand first arose for Terns, 'Sea-Swallows,' or 'Summer Gulls,' for millinery purposes, so many were killed on Cobb's Island that several species were practically exterminated there. In one day 1400 Least Terns were shot; and in three days three baymen shot 2800 Terns of various species. The State of Virginia subsequently passed a law protecting these birds, and the American Ornithologists' Union now provides a warden to enforce it during the nesting season. As a result the birds are increasing in numbers, and it is hoped that they may become as abundant as they were formerly.

The group was prepared under the direction of Frank M. Chapman, from studies and photographs made by him on Cobb's Island, in July, 1902. The background was painted by W. B. Cox. The birds were mounted and arranged by H. C. Denslow, of the Museum's Department of Preparation.

Sixty-three individuals of the following six species are shown: Least Tern, Gull-billed Tern, Common Tern, Skimmer, Wilson's Plover, and Oyster Catcher. In most instances the eggs and young at various stages are represented.

THE NEW INSECT HALL.

The new hall of the Department of Entomology, in the gallery floor of the east wing of the Museum, is now open to the public. In this hall there is now on exhibition, for the first time, the entire magnificent collection of butterflies of America, north of Mexico, and from other parts of the world, which was generously donated to the Museum by the late Very Rev. E. A. Hoffman. It contains about 2000 species, represented by over 5000 specimens, and is arranged in fourteen large double cases, containing specimens from Mexico, Central and South America, India, Malay Islands, Australia, Japan, Africa and Europe. The North American butterflies are installed separately in four cases, nearly all the species found in this country being represented.

Among the most noteworthy species in the general collection are the Brilliant Blue Morphos, Owl-faced Butterflies (*Caligo*), the Swallow-tails (*Papilio*), Citron, Orange, Lemon, and White Butterflies belonging to the family Pieridæ. A good representation of the Milk-weed and Glass-winged Butterflies and allies is also shown. A beautiful example of *Papilio homerus* from Jamaica, B. W. I., and of *Dynastor napoléon* from Rio Janeiro, Brazil, are exhibited, as well as many other rarities.

In the railing cases of the hall is exhibited a collection of insects found within fifty miles of New York City, which was transferred from the main hall, where it was on exhibition formerly. The hall also contains collections of economic entomology and insect architecture.

At the entrance of the hall is a large case containing specimens of Termites' nests from Colombia, Jamaica, and the Bahamas. The specimen here figured was collected by Prof. R. P. Whitfield in Graytown, a suburb of Nassau on the island of New Providence, Bahamas. It is about three feet high and twenty-two inches in diameter. This interesting specimen was found in the midst of a pineapple plantation and was built on an old cedar stump. It is composed of vegetable mold which accumulates in the cavities of the coral formation of the island. Professor Whitfield informs us that the settlers of the islands encourage these insects for the purpose of feeding them to young chickens. The other nests in the case were collected by Dr. F. C. Nicholas. Owing to their resemblance in appearance and in habits to ants, Termites are wrongly called "White Ants." They are found in the warmer parts of the world and are said to be useful as well as injurious. In uninhabited districts they are valuable, owing to the fact that they feed essentially on dead wood, and are the means of clearing the forests of decayed trees.

They also feed upon other substances, and in settled regions they often attack houses, and in this respect do considerable mischief to the woodwork by devouring the interior of the frame and posts. They never break through the exterior, but leave a shell scarcely thicker than ordinary paper, so that nothing without indicates the cavity within.

NEST OF TERMITES

In the case with the Termites' nest is exhibited a specimen of a wooden plank from a house attacked by these pernicious insects. Disliking the light, they always work under cover building a tunnel from the ground to their nest in a tree. Some species of Termites build nests of clay.

Thousands of these insects inhabit a single nest, a colony consisting of a queen, males, workers, and soldiers. The workers and soldiers are without eyes.—W. B.

THE ANDREW J. STONE COLLECTION OF 1902.

Mr. Stone and his assistants spent the season of 1902 mainly in northern British Columbia, although the first few weeks of the season were spent by Mr. Stone in the western part of the Alaska Peninsula, which he revisited to obtain accessories for the setting of the Grant Caribou group, and, if possible, to obtain additional specimens of the large Alaska Bears. The bear hunt was unsuccessful, owing to the fact that the bears of the region visited have become practically exterminated by the big-game hunters. Mr. Stone, however, succeeded in securing an exceedingly valuable series of skulls of the famous Kadiak Bear, the largest known living land carnivore.

The main work of the season was begun at Wrangel, Alaska, in June, and later was extended inland to the upper Stickeen River region, in northern British Columbia, and at the close of the season a month was again spent in the neighborhood of Wrangel, on the Alaskan coast.

The present year's work was restricted to the gathering of mammals, both large and small, with the result that the largest and most important collection of mammals ever made by any party in a single season in northern North America was secured and brought to the Museum in perfect condition. The large game, numbering some fifty head, includes a fine series each of Moose, Caribou, Sitka Deer, Mountain Goats and Mountain Sheep, besides a few Bears, Wolves, Foxes, Wolverenes, etc. The small mammals number about a thousand specimens and represent, in large series,

nearly all of the species of the regions visited, and include a number scarcely represented before in any museum, while nearly all are new to our own collection, and hence of the highest importance. Especially noteworthy is a large series of the Golden Lemming, of which we had previously but a single immature specimen, and of which only a very few had ever been seen by naturalists. Among other noteworthy specimens mention should be made of the series of Osborn Caribou, the largest and handsomest known species of the group, and also of the Stone Sheep, both discovered in this same region by Mr. Stone on previous expeditions.

FORTHCOMING REPORT ON THE SIBERIAN MAMMALS COLLECTED BY THE JESUP NORTH PACIFIC EXPEDITION.

In addition to the ethnological work undertaken in eastern Siberia by the Jesup North Pacific Expedition, extensive collections were made in natural history, particularly of mammals, birds and fishes. Mr. N. G. Buxton of Johnstown, Ohio, an experienced collector, was especially employed for the natural history work during the years 1900 and 1901, and a considerable number of specimens were also secured by other members of the expedition. A report on the mammals has already been prepared for publication in the Museum Bulletin, and other reports will follow on the birds and fishes. The collection of mammals numbers over 500 specimens, representing 30 species, of which about one third have proved new to science. The material is all new to the Museum, and includes a large number of specimens that will be eventually mounted for exhibition.

A number of the new species show unexpectedly close relationship with American species, and give evidence that eastern Siberia has derived some of its present mammalian life from boreal America, and doubtless within a comparatively recent period. The American origin of various early types that eventually attained circumpolar distribution, as the horse, camel and

rhinocerous phyla, etc., is now well established by palæontological evidence, but that the same is true of some forms of the existing mammalian fauna does not appear to have been heretofore generally recognized.

A NEW SPECIES OF COTTON FROM A PREHISTORIC RUIN IN UTAH.

In one of the collections gathered by the Hyde Expedition for this Museum there has been found a species of cotton hitherto unknown to science.

This collection was made by the Wetherill brothers in 1894–95. The greater part of the material is from caves and cliff houses of the Grand Gulch region of southeastern Utah and many new and interesting objects have been discovered in the course of renumbering and cataloguing.

Probably the most interesting discovery to scientists in general is a number of cotton bolls that were found in a corrugated jar that rested against the head of a skeleton of a "Mound Dweller."

This jar is from one of the numerous mounds of the "Mesa Ruins," as they are termed by one of the Wetherills, in the Grand Gulch country of Utah. In the jar were over sixty capsule cells, or seed-bearing sections of bolls, some of which contained cotton, also small ears of corn, seeds, cotton cloth, arrow points, iron ore and pebbles.

Samples of this cotton were sent to Professor C. F. Millspaugh of the Field Columbian Museum, Chicago, for study: the results of his investigations are embodied in the following letter:

"The cotton from jar 175 does not correspond to any known species. I have described it under the name *Gossypium aborigineum* as a new species and probably the progenitor of our tropic American *G. arboreum*." Professor Millspaugh is preparing a technical description of this new species, which will appear in one of the botanical journals.—G. H. P.

NEWS NOTES.

MR. GEORGE HUNT of Fort Rupert, Vancouver Island, who has been collecting for the Museum for six years, is at present staying in New York, and is engaged in the arrangement of the collection which he has made. The material collected by him represents the culture of the Kwakiutl Indians, and some of the results of his work for the Museum have recently been published in the Memoirs of the Jesup North Pacific Expedition. A number of models illustrating the methods of fishing and hunting of the Kwakiutl Indians are at present being made by Mr. Hunt, assisted by Mr. Orchard. When this work is completed, a full collection of all the fish-traps used by these Indians will be in the possession of the Museum. Mr. Hunt is also revising the material of the collection with a view to filling in all the remaining gaps.

DR. E. O. HOVEY, Associate Curator of Geology, who has returned to the Lesser Antilles to continue his studies of volcanic activity in those islands, writes from St. Vincent, under date of March 5, as follows: "Tuesday, March 5, we ascended La Soufrière in favorable weather and had the good fortune to witness three fine outbursts while we were on the rim of the crater." Of Mt. Pèlee, in Martinique, which he had climbed only a short time previous, he writes: "The new cone is a remarkable affair with a tremendous 'tooth' projecting 500 feet above the main body of the cone. . . . There have been several changes in the mountain since last July, the most striking of which are the building of this cone and the almost complete filling of the Rivière Blanche with debris from eruptions."

THE group of Little Black Rail recently placed on exhibition in the Monkey Hall is the only known one of its kind. Adult birds of this species are both rare and, owing to their secretive habits, difficult of capture, while the young appear not to have been observed before those contained in this group were collected. They were brought to Mr. H. H. Brimley of Raleigh,

N. C., in the egg by a negro who had discovered them in the nest. Hearing a *peep* from one of the eggs, Mr. Brimley placed them in a warm place, where they soon hatched. The young were then kept alive until they were twenty-four hours old, when they were preserved and subsequently mounted by Mr. H. C. Denslow of the Museum's Department of Preparation.

A FINE series of fossils from the Cretaceous chalk strata of western Kansas has been purchased for the Museum from the veteran collector, Chas. H. Sternberg. It includes a Mosasaur, or Great Marine Lizard skull with part of the skeleton, of the largest size and in splendid preservation, a complete fossil fish about twelve feet long, and a number of other valuable specimens.

MR. J. H. BATTY, who is collecting birds and mammals for the Museum in the mountains of northern Mexico, writes that about twenty wolves raided his camp at night recently, badly wounding his dogs and damaging some freshly prepared deer skins. The incident, however, resulted in the addition of three wolves to Mr. Batty's collection!

THE Department of Public Instruction has secured from Mr. A. J. Campbell of Melbourne, Australia, twenty-two negatives of the nests and eggs of the more characteristic Australian birds, including the King Bird of Paradise and Emeu.

THE New York Academy of Sciences has deposited its valuable library of about 10,000 volumes in the Museum. It is especially rich in the publications of foreign societies, a branch of scientific literature before but poorly represented in the Museum's library.

GENERAL J. WATTS DE PEYSTER has donated to the Museum some 250 volumes on general natural history, none of which were before contained in its library.

Mr. GEORGE F. KUNZ has been appointed Honorary Curator of Gems.

AN EJECTED BLOCK FROM PELÉE—BROKEN BY ITS FALL

On the Sèche-Blanche Plateau, one and one-half miles from the crater.
From a photograph taken by E. O. Hovey, February 26, 1903

The American Museum Journal

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WITH this number the Journal begins its appearance as a quarterly. It is proposed to have each part contain a larger number of pages than heretofore, and the publication of the guide leaflets will be continued. The popular demand for the guide leaflets is very gratifying, about 2250 copies having been sold at the entrances to the building during the first six months of this year. The usefulness of the guide leaflets has been extended, furthermore, by their republication in whole or in part in other periodicals, among which may be mentioned the "Scientific American," "Rider and Driver," "Globus" and "World's Work."

The Guide Leaflet issued as the supplement to the current number of the Journal has been prepared by Charles W. Mead, of the Department of Archæology, and pertains to "The Musical Instruments of the Incas." Mr. Mead has based his studies upon the remarkably large collection of prehistoric Peruvian musical instruments which was assembled on the Henry Villard and other expeditions. The Museum's collection of these objects and pottery vessels showing their use, installed on the third floor of the west wing, is thought to be the largest and best in existence.

MARTINIQUE AND ST. VINCENT REVISITED.

The year 1902 was noteworthy for the large number of volcanic outbursts reported from various parts of the world, but it will be remembered particularly for the eruptions which took place from the volcanoes Pelée on the island of Martinique and

La Soufrière on the island of St. Vincent, in the chain known as the Lesser Antilles or Caribbean Islands. These eruptions aroused the greatest popular interest on account of the destruction of some 32,000 people on Martinique and 1600 people on St. Vincent, while the interest of the scientific public was aroused on account of their supposed peculiar character, and probably no cataclysm of nature has been studied, photographed and written about to such an extent in so short a time as have the eruptions which visited these beautiful islands in 1902. The writer's first investigations in these islands having been carried on in the rainy season, and during and directly after the exciting incidents accompanying the first terrific explosions of the volcanoes, it was thought best to make a second expedition during the latter part of the dry season, to learn what changes had taken place in the volcanoes, and to extend observations to the other islands of the group, for the purpose of making comparisons between the volcanoes in action and those supposed to be extinct. Consequently, on February 5 the writer left New York by the steamship "Caribbee" of the Quebec Steamship Company, and after three months returned by the "Korona." Four weeks of the time were devoted to Martinique, two weeks to St. Vincent, and the remainder was divided among St. Lucia, Dominica, Guadeloupe, Montserrat, Nevis, St. Kitts, Statia and Saba. The weather conditions were superb, and many valuable photographs were added to the Museum's already extensive collection of views of the region.

LA MONTAGNE PELÉE, MARTINIQUE.

Undoubtedly the most striking change which has taken place in Martinique is the addition to the sky-line of Pelée of the new cone with its tremendous summit spine. The eruption which began to make itself manifest in April, 1902, had its origin in several openings around the small lake, L'Étang Sec, which existed in the bottom of the enormous crater of the mountain. When the writer first saw the mountain on May 21, 1902, there was visible within the great crater a small cone which had been

1. SOUTHWESTERN PART OF PELÉE, SHOWING THE ASH-FILLED GORGE OF THE RIVIÈRE BLANCHE, FEBRUARY 17, 1903

E. O. Hovey, Photo.

2. A PORTION OF THE ASH-FILLED GORGE OF THE BLANCHE, FEBRUARY 20, 1903

built up by the renewed activity of the volcano, but as yet it was not a pronounced feature of the landscape. Since that time the great cone has been built up, the spine of which lifts its head nearly 5150 feet above the sea, according to the triangulation of the French geological commission. The former altitude of Pelée as given on the charts was 4428 feet. The new cone is a composite affair made up of solid lava and fragmental material, the latter consisting of scoriæ from the vents or the fissures forming the outlet of the volcanic energies and débris from the solid lavas. The solid lava, which is rifted in every direction, forms the great spine and the ribs or buttresses which project from the mass of the new cone.

At the present time the principal craters of Montserrat and Nevis appear to be in almost exactly the same condition, save for the absence of the crater lake, as that of Pelée before the present series of eruptions began. The crater of Pelée was breached on the southwest by a tremendous cleft opening directly into the gorge of the Rivière Blanche, and when the vents to the west of L'Étang Sec burst forth with all their strength on May 8, 1902, this cleft and the surrounding walls on the remaining sides of the crater gave direction to the volcanic blasts which overwhelmed St. Pierre. From that time to the present, the course of the Rivière Blanche has been the line most frequently pursued by the dust-laden clouds of steam rolling from the volcano's mouth, until now the old gorge is nearly filled with the new débris. The course of the old gorge is well marked by the belt of white ash extending from the crater to the sea. The surface of the ash is littered with blocks of all sizes up to enormous masses thirty feet across.

Examination of the material filling the gorge of the Blanche confirms the idea held last summer, that the volcanic dust, sand and gravel which form by far the largest proportion of the beds in the gorge, issued from the cone or center of eruption in a dry condition. The live steam permeating the mass caused the whole to act like a fluid, and rush down the gorge in a torrent which carried with it the blocks of new and old lava. The solid particles were incandescent, and the steam rose in

vast clouds as it was liberated from the flowing mass, so that the statement made by some observers, that streams of lava flowed from the crater, is not surprising. The clouds of steam carried away into the atmosphere enormous quantities of the finest ash. These dust-flows, however, down the Rivière Blanche must not be confounded with the mud-flows down the same cañon and down the outer slopes of the mountain.

Studies on the other islands of the Caribbean chain lead to the conclusion that the Soufrière of Guadeloupe and the peak of Saba have had essentially the history through which Pelée is now passing, though without the formation of a single prominent spine. The analogy is especially close in the case of Guadeloupe, where the present Soufrière is a great cone ribbed with masses of solid lava filling and rising above the ancient crater. There is no definite pitlike opening in Pelée now, nor is there such a crater on Guadeloupe's Soufrière or the peak of Saba, though there is a shallow oval bowl in the top of the last named. Bread-crust bombs, like those so abundantly thrown out by the present action of Pelée, occur on Guadeloupe and Saba.

The full description of the new cone and spine and of other changes observed on and about the mountain, such as the filling of the gorge of the Rivière Blanche by dust and boulders from the crater, the effect of erosion on the mountain slopes, the encroaching of vegetation on the limits of the area devastated by the earlier eruptions, and the antiquated appearance of the ruins of St. Pierre must be left to a more comprehensive report.

LA SOUFRIÈRE, ST. VINCENT.

St. Vincent recovers more slowly than Martinique from the great eruptions of 1902. This is due not only to the greater amount of ash thrown out by the Soufrière, but also to the higher specific gravity of the material, which prevents its being washed off the ground as rapidly as the dust from Pelée. The region which was devastated by the May eruptions and revisited with tornadic blasts in September and October, 1902, still is bare of vegetation, except as new herbage has sprung up from roots

1. LOOKING INTO CRATER OF PELÉE MARCH 25, 1903. REMAINS OF MORNE LACROIX AT LEFT, BASE OF NEW CONE AT RIGHT

E. O. Hovey, Photo.

2. LOOKING INTO CRATER OF LA SOUFRIÈRE MARCH 10, 1903. SURFACE OF BOILING MUD LAKE IS ABOUT 2500 FEET BELOW POINT OF OBSERVATION

left in protected spots on steep slopes from which the ash has been removed. Beyond this district, the area which was seriously injured by the September and October eruptions has recovered its crops and general verdure. The outbreak of March 22, which deposited three inches of ash in Georgetown, according to the newspaper reports, must have destroyed the experimental work which was being done toward the resuscitation of the Mt. Bentinck and other estates between Georgetown and the crater. The most impressive change which has taken place on St. Vincent since June, 1902, is the excavation which has been accomplished by the Wallibou, the Rabaka and other rivers in the enormous beds of ash which were left in their gorges by the eruptions. From the gorge of the Wallibou alone not less than 150,000,000 cubic feet of material has been carried out to sea in a few months.

The general impression among local observers is that the crater is considerably larger now than it was in June of last year, especially in the direction from east to west, but the writer's photographs of the great pit which were taken May 31, 1902, look so much like those taken from the same spots March 3 and 10, 1903, that it does not seem safe to assert that any great change in the upper part of the crater, at least, has taken place during the intervening months. Some enlargement, however, must have taken place, due to the numberless landslides which have carried portions of the inner walls to the bottom of the crater to be thrown out by a succeeding eruption. Last May the writer estimated the surface of the lake in the bottom of the crater to be about 2200 feet below the highest point of the rim,[1] but on March 3, 1903, he made the lake out to be 2600 feet below the same point. These are mere estimates, however, no accurate measurements being practicable.

The volcano was showing considerable mild activity early in March, 1903, and some of the local observers, Rev. Thomas Huckerby of Chateaubelair in particular, were of the opinion that a

[1] Dr. T. A. Jaggar, Jr., who was a member of the same party, concurred in this estimate, but George Carroll Curtis, also a member of the party, estimated the depth at 2400 feet.

great eruption was near at hand. Their fears were fully realized on March 22, when an outburst of first magnitude occurred.

When Professor and Mme. Lacroix, Lieutenant Deville, Mr. Huckerby and the writer partly circled the rim of the crater on March 3 and the last two completed the circuit on March 10 they witnessed several outbursts from near the center of the lake of boiling mud in the bottom of the crater. These outbursts began with an uprush of black mud mingled with white steam rising like a fountain many yards above the surface of the lake, but falling back directly. Then through the black and white mass rose with a roar the brown and gray dust-laden column of steam with the beautiful and familiar cauliflower convolutions. These eruption columns rose far above the summit of the mountain on the earlier date and the mud falling from them liberally sprinkled the observing party with gray. Many stones could be seen rising like rockets through the mud and dust of the column within the crater, leaving behind them long trails of white steam. The stones all fell back within the crater on these days, but scores of freshly ejected ones were to be found on the rim and the outer slopes of the great cone. When on the rim, May 31, 1902, the writer observed mud eruptions issuing from the southeastern quarter of the lake then existing in the bottom of the crater, which were just like the first stage of the outbursts here described.

The eruption of 1812 formed a new and smaller crater to the northeast of the great cauldron. The eruptions of the present series have not opened this conduit again, but have confined themselves entirely to the great crater which was the vent for the 1718 and earlier eruptions. The outburst of October 16, 1902, threw an immense quantity of heavy ash into the 1812 crater, reducing its depth from 500 feet to 260 feet below the highest point of the surrounding rim. The knife-edge ridge known as the "saddle" which existed between the two craters before May 7, 1902, has disappeared. Probably it slid down into the great crater after being undermined; and the material was then thrown out during some of the eruptions. Fumaroles have appeared in the rock wall bounding the 1812 crater on the

E. O. Hovey, Photo.

TWO STAGES OF A MINOR OUTBURST OF LA SOUFRIÈRE, ST. VINCENT, 7:55 A.M. MARCH 3, 1903

north; also in the rock of the south side of the head of the Larakai valley leading from the west side of the great crater; and in a crevice below the rim of the crater on the southwest side. The volcanic bombs of the Soufrière do not show the "bread-crust" surface as typically as the bombs of Pelée. The Soufrière lava is a heavier, blacker material than that of Pelée. No *stream* of molten lava has issued from either volcano during the present series of eruptions.

The western or leeward side of the mountain still presents differences from the eastern or windward side. In May and June, 1902, the material coating on the leeward slopes seemed finer in grain than that on the windward slopes. The leeward slopes, especially of the upper half of the mountain, were slippery with deep mud, while the coating on the windward side was much looser in texture and there was little of the cement-like mud below the summit plateau. The eruption of September, 1902, left on the leeward slopes a hard, gravelly surface on which there are countless cindery black bombs of all sizes up to eight or ten inches in diameter. The September eruption did not have much effect upon the windward side; but the material from the October eruption passed, for the most part, in that direction, without, however, changing the loose character of the coating on the slopes.

The great crater of Mt. Misery on the island of St. Christopher (St. Kitts) shows, on a smaller scale, just what the Soufrière was before May, 1902; and St. Eustatius (Statia) is another example of the same kind, though on a still smaller scale. Both are great open pits or calderas, entirely surrounded by walls of very irregular height. The crater of St. Eustatius contains no body of water; but that of Mt. Misery has within it a shallow lake, except toward the end of the dry season. The volcano of St. Eustatius is entirely extinct, but Mt. Misery has a considerable solfataric area (called a "sulphur" by the English West Indians) along the northeast wall of its crater. Bombs occur on the slopes of the St. Eustatius volcano which are closely similar to those thrown out by St. Vincent's Soufrière during the recent eruptions.

The island of Nevis culminates in a great volcanic cone containing a pitlike crater which has been cleft to its base on the northwest side. This cone, like those of Pelée and the Soufrière of St. Vincent, shows the remains of an older and larger crater-ring partly surrounding it, just as Monte Somma partly encircles Vesuvius. The island of Saint Lucia has an ancient appearance geologically and shows no great recent cone dominating the island like the islands which have been cited. Dominica is a large island showing hot and boiling springs and sulphurous steam vents at several localities, but it also has no single dominating volcano, unless it be Morne Diablotin. The Boiling Lake in the southern part of Dominica occurs in what may perhaps be considered a badly broken-down crater.

The questions of supreme importance to the inhabitants of Martinique and St. Vincent are: "Have the eruptions ceased? Is there any danger to be feared beyond the present zones of devastation?" Unfortunately the first question cannot be answered since there is no sure way of predicting a serious outbreak long in advance. Last fall certain French and American scientists predicted that Pelée would suffer a heavy eruption on December 20, 1902. This prophecy was not fulfilled at all, nor was that that La Soufrière would explode again in January, 1903. Pelée has not had a great eruption since August 30, 1902; but La Soufrière had one on March 22, as already stated. There seems, however, to be no real cause for alarm for the islands outside the present zones of devastation, since the destruction wrought last year appears to mark the limit of the present volcanic energy. No prediction can be made for the other Caribbean islands, but there seems to be no ground for present anxiety regarding their volcanoes, except as to Guadeloupe's Grande Soufrière, the fumarole area seems to be spreading, and to show slowly increasing activity.

E. O. Hovey.

1. ASH-FILLED GORGE OF WALLIBOU RIVER, ST. VINCENT, MAY 30, 1902

E. O. Hovey, Photo.

2. THE SAME AREA, MARCH 7, 1903, SHOWING ENORMOUS AMOUNT OF EROSION

THE COLLECTION OF FISHES.

THE first instalment of a much needed addition to our collection of fishes has been received recently at the Museum. It consists of five specimens of Bahama fishes which have been specially prepared. The work has been done by Sherman F. Denton, who has given many years' study to fish preparation, and the results are most satisfactory. The chief reason that attractive collections of fishes are so seldom seen in museums is that no fluid has been discovered which will preserve their natural colors with any degree of permanency. The usual method of placing fish in round jars of alcohol is unsightly and unsatisfactory, while casts in plaster or wax are only casts, not specimens. The ideal method of exhibition would be to have the fishes, in their natural colors, mounted in fluid, and in a lifelike position. At present, however, this is impossible, and these specimens, prepared according to Mr. Denton's method, serve as fair substitutes. The process of preparation requires considerable skill and artistic ability. The skin of the fish is removed by cutting down one side of the body. It is then treated with preservatives and fitted over a papier-maché model. The side to be exposed to view is painted in oil, to give a lifelike color, and the completed specimen is mounted in a natural position on a suitable background.

A NEW COLLECTION OF FOSSIL SPONGES.

THE sponges which are so familiar to the public are the horny skeletons of colonies of animals of low development. The living animals inhabit tropical oceans and seas, and, although so often seen in shops and homes, are perhaps the least common of the scores of species of sponges which occur so plentifully in the warm parts of the ocean, to say nothing of the many other and very abundant forms found in the colder seas. When living, the commercial sponges are very unattractive, the animal being

black or dark brown in color, whereas many of the non-commercial sponges have brilliant hues and other attractive features. Sponges as a class have existed in nearly all ages of the earth's geological history, and in many periods were extremely abundant and varied in form.

The Museum recently has come into possession of a remarkable series of fossil sponges from the collection of Dr. Schrammen of Hildesheim, Germany, all of which are from the Cretaceous or Chalk formation of northern Germany and are mostly from, in or near the little towns of Misburg, Oberg and Nettlingen. These sponges all belong to the great subdivision of the class in which the skeleton is composed of siliceous, or glassy, spines (called "spicules") and rods. The specimens from Misburg are in a light-colored clay, in which the form and even the surface features are preserved. Those from Oberg have been skeletonized; and although they are extremely fragile, they show the structure of the sponge almost as well as do the living organisms. The specimens from Nettlingen are preserved as iron oxide (yellow ocher), and show only the external form, without the microscopical structure. Some of the most striking forms in the Schrammen collection have been placed on exhibition in one of the desk cases in the Geological hall.

DEPARTMENT OF VERTEBRATE PALÆONTOLOGY.

THE halls of vertebrate palæontology have been completely rearranged in connection with the removal of the Dinosaurs and other reptiles to the new hall in the southeast wing. The fossil mammals are now arranged on the "alcove system," replacing the "aisle system" which has been found to be confusing to the public. In the new system, each alcove at the side of the hall is devoted either to a single family or to closely related groups of mammals, so that the visitor can readily get his bearings and, especially, appreciate the remarkable force of the evolutionary succession. The alcoves as at present arranged are as follows:

1. A SECONDARY DUST-FLOW FROM THE ASH-BED IN THE GORGE OF THE WALLIBOU RIVER, ST. VINCENT. THE FLOW PROBABLY OCCURRED MARCH 6, 1903

E. O. Hovey, Photo.

2. THE SOURCE OF THE DUST-FLOW SHOWN IN FIGURE 1

Photographs taken March 7, 1903

SOUTH SIDE.

Alcove No.

1. Titanotheres
2. Rhinoceroses
3. Horses and Tapirs

} Perissodactyls ("odd-toed" hoofed mammals).

NORTH SIDE.

Alcove No.

1. The most primitive hoofed mammals (Amblypods and Condylarths).
2. Insectivores, Rodents and the most primitive Mammals generally.
3. Flesh-eating Mammals (Creodonts and Carnivores).
4. Marine Mammals (Seals, Cetaceans and Sirenians).
5. Proboscidea (Elephants and Mastodons) in the center of the hall on the north side.
6. Pigs, Peccaries, Elotheres and other Artiodactyls ("even-toed" hoofed mammals) with simple conical cusps in the molar teeth.
7. Creodonts and other primitive Artiodactyls with crescentic molar teeth.
8. Pecora, or Ruminating Artiodactyls (those that chew the cud).
9. Edentates and South American fauna generally.

As a centerpiece has been placed the great head and tusks of the Imperial Mammoth, and with it a gigantic tusk of the Woolly Mammoth, from the new Siberian island, which has been secured recently through the Department of Anthropology.

The guide leaflet descriptive of the Hall of Vertebrate Palæontology is undergoing complete revision and expansion to meet the new conditions, and will be issued in the fall.

NEWS NOTES.

THE thirty-fourth annual report of the Museum, being the twenty-second report of Morris K. Jesup, Esq., as president, was issued in May. It shows clearly the wide scope and the importance of the activities of the institution. Those interested may obtain copies upon application.

GROUND is being broken on Manhattan Square, west of the new lecture hall, for the construction of an addition to the Museum building of interest both to members and to the visiting public. The new structure will be a thoroughly modern heating, lighting and power plant, which when completed will add a most attractive, appropriate and instructive feature to the already extensive series of exhibition halls. It is the purpose to have the apparatus for the conversion and transmission of heat, light and power open to the public, and instructively labeled and described.

ON June 16, the Board of Aldermen authorized an additional bond sale to the amount of $188,000 for constructing the approaches to this new wing, for building a foyer to take the place of the old lecture hall and for other additions and improvements about the building. Among these additions will be two assembly-rooms for the use of scientific gatherings and visiting classes.

DIRECTOR BUMPUS, Professor Allen and Mr. Chapman attended the annual convention of the American Ornithologists' Union, which was held in San Francisco in May. At the convention announcement was made of the award to Professor Allen of the Walker Grand Prize in Natural History by the Boston Society of Natural History.

In announcing the award to its recipient, Prof. Charles S. Minot, president of the society, wrote as follows:

"It gives me great pleasure to inform you that the Walker Grand Prize has been awarded to you by a unanimous vote of the Council for your able and long-continued contributions to North American Ornithology and Mammalogy. The amount

of this prize is five hundred dollars, but in view of the high character of your investigations it was further voted to increase the amount to one thousand dollars.

"I am very glad to have the privilege of conveying to you the official announcement of this public recognition of the exceptional value of your services to science, which I hope you may continue to render for a long time."

Frank M. Chapman, Associate Curator of Mammalogy and Ornithology, is in California collecting material for making a group on the Cadwalader fund. He has an artist with him, who will make a study of the region in which the birds are found from which groups along the same lines as the new Cobb's Island group, described in the last number of the Journal, will be constructed. One of the proposed groups will represent the bird-life of the irrigated portions of the San Joaquin valley, and will include Stilts, Avocets, Cinnamon Teal, Coots, all breeding or with young, Forster's and Black Terns, Pintail and Redhead Ducks, Great Blue Heron and Yellowheaded and California Red-winged Blackbirds. The background will show a great stretch of green irrigated country with the mountains of the Coast Range in the distance.

The plans of the Department of Vertebrate Palæontology for field work this season are now being carried into execution. Walter Granger, accompanied by Albert Thomson, has gone into the old and much-explored beds in the region of Fort Bridger, southwestern Wyoming. Despite the fact that the Yale, Princeton and American Museums have already made rich collections from this region, there is reason to believe that as "there are still more fish in the sea," so there are still fossils to be found in the Bridger region which will settle some of the most important and interesting problems in the descent of mammals. Chief among these problems is perhaps the origin of the rhinoceroses. We also especially desire to secure the Middle Eocene stage in the evolution of the horse in such complete form that it can be mounted in the remarkable series which is now being collected with the aid of the William C. Whitney fund. Another object

of this expedition is to secure the comparatively small amount of material needed to mount the skeleton of *Uintatherium*.

Barnum Brown has proceeded to southwestern Dakota to explore certain marine Cretaceous beds, in the hope of finding additional remains of Mosasaurs, or Sea-lizards, and Plesiosaurs, or long-necked marine reptiles. The Museum collection is particularly wanting in the *Plesiosauria*, although it is true that we have a superb specimen of *Elasmosaurus*, presented by Mr. Jesup in the second Cope collection, also a nearly complete skeleton of *Cryptoclidus*, presented in exchange by the British Museum of Natural History, from the English Middle Jurassic. Both these skeletons, however, unfortunately lack the skull, a part which has very rarely been found, and this is naturally the great desideratum, which we hope to supply, at least for *Elasmosaurus*. The skull of the English Plesiosaur is promised us from the British Museum.

A third party, under the direction of Peter Kaison, is continuing the excavation of the Reed Quarry and of the Bone Cabin Quarry in Wyoming, which have been so rich in results.

The Whitney Expedition, conducted by J. W. Gidley, is continuing the search for fossil horses in South Dakota. Dr. W. D. Matthew will join this expedition for a part of the season, and Dr. O. P. Hay will spend a short time with Mr. Granger's expedition in the Bridger Basin, Wyoming.

Among the specimens recently mounted and placed on exhibition in the Department of Vertebrate Palæontology are the skeletons of the Saber-tooth Tiger from the Cope Pampean collection, and of the *Glyptodon* from the Whitney Texas collection. Two new fossil proboscidean skulls make, with the two already on exhibition, a unique and impressive series illustrating four stages in the evolution of the Elephants.

Professor Albert S. Bickmore sailed for Europe on June 10 for the purpose of making an extended tour in connection with the work of the Department of Public Instruction. He will revisit Holland, Belgium, Southern Germany, Austria and Hungary, and will be followed by Messrs. Abegg and Hofer, his

photographers, who will make the negatives to be used in the preparation of his new lectures on Europe.

THE subjects for Professor Bickmore's lectures to teachers and to members of the Museum next fall will be, "The Development of New York City," "Niagara," "Berlin" and "Potsdam and Vicinity."

THE DUKE OF LOUBAT, to whom the Museum is so much indebted for the development of its collections in Mexican archæology, has again shown his interest in American archæology by the liberal endowment of a chair in Columbia University, which has been designated as the "Loubat Professorship of American Archæology." The Trustees of Columbia have appointed as the incumbent Marshall H. Saville, Curator of Mexican and Central American Archæology in this Museum. This is the third professorship of American archæology which the Duke of Loubat has endowed,—the other two being at the University of Berlin, and the College of France.

PROFESSOR SAVILLE, is spending the month of July in Mexico. A part of the time will be devoted to the ruins of Mitla in order to complete his observations and obtain additional photographs for the report on the explorations recently carried on there by the Loubat Expedition, and to make further studies of Zapotecan antiquities. While he is in the City of Mexico arrangements will be made for an exchange of archæological specimens between the Muséo Nacional and the American Museum.

H. H. ST. CLAIR, 2d, has gone to Oregon to make an extended stay among the Indians of Siletz, Oregon. Mr. St. Clair is carrying on the ethnographical investigation of the Indian tribes of the Far West through the coöperation of the United States Bureau of Ethnology with the American Museum.

THE use of the collections of the Museum by classes of pupils from the public schools is increasing. President Jesup has directed that the duplicates of the exhibition series be made accessible to use by the school children. For several years small collections of rocks and minerals have been loaned to teachers asking for them, but this has not brought the Museum

into the desired intimate connection with the schools of the city to the degree accomplished by the present extension of the plan. Recently classes of high-school boys and girls have been at the Museum examining and handling mounted skins and skeletons of mammals in their study of Natural History. Teachers desirous of having their pupils study nature in this concrete manner make application for the privilege, stating the specimens needed and the line of work proposed. On the specified day the material may be handled by the children under the guidance and supervision of some member of the Museum staff.

Harlan I. Smith, Assistant Curator of Archæology, who is making investigations for the Museum in the State of Washington, writes from the field that he has discovered prehistoric pictographs carved in the rocks of the north side of Selah Cañon near North Yakima. Such carved inscriptions are known along the coast, but they have not been found heretofore in the interior. Mr. Smith also reports finding a prehistoric quarry in the same region from which the early Indian inhabitants obtained material for the manufacture of flint arrowheads.

John Hancock of Philadelphia spent a few days in June going over the specimens of the Bement mineral collection in Morgan Hall to add items of interest to the labels. Mr. Hancock had the care of the collection for many years while it was growing under Mr. Bement's hand; and for this reason he has been able to make valuable suggestions regarding the collection as displayed in the Museum

A magnificent garnet crystal from Salida County, Colorado, has just been added to the gem collection, a gift from David L. Gluck, Esq. The crystal is nearly five inches high, weighs five and one-half pounds and is like a model in its symmetry of development. The exterior has been altered to the familiar green chlorite to a slight depth, but the interior has not been affected by the decomposing agencies.

During the last week in June the Department of Mammalogy and Ornithology received from J. H. Batty his second shipment of skins and skulls of birds and mammals. The shipment contained 457 birds of many species, 18 Deer, 4 Coyotes, 1 Fox, 11 Jack Rabbits, 4 Skunks, 315 small Rodents, 18 Spermophiles, 1 Squirrel, 10 Bats and 1 Turtle. The animals were obtained amid the high mountains of northern Mexico, and represent the fruits of much hard labor and exposure. In January Mr. Batty sent in his first shipment of the present expedition, consisting of 142 skins of mammals collected in southern New Mexico.

The Musical Instruments of the Incas

A Guide Leaflet to the Collection on Exhibition
in the
American Museum of Natural History

By

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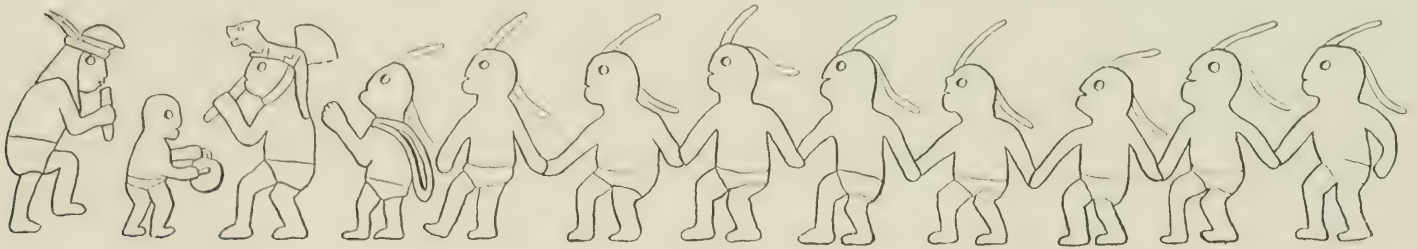


FIGURE 1

FIGURE 2

PLATE I. DECORATIONS FROM ANCIENT PERUVIAN TERRA COTTA VESSELS

THE MUSICAL INSTRUMENTS OF THE INCAS.

By Charles W. Mead,

Assistant, Department of Archæology.

INTRODUCTION

Ancient Peru, the land of the Incas, extended, according to the historians, Garcilasso de la Vega [1] and Prescott, [2] from about the second degree of north latitude to the Maule River in Chile, about the thirty-sixth degree of south latitude. The country included the region now comprised within the Republic of Peru, and the greater part of Ecuador, Bolivia and Chile, and was nearly equal in size to that part of the United States east of the Rocky Mountains. The Incas had no written language, and no small part of our knowledge of their customs has been derived from their practice of representing the scenes of daily life in the decoration of their pottery vessels. In the study of the musical instruments in particular, the decorations on the pottery of the ancient Peruvians is important, because the Spanish conquerers of the land and their followers have left in their accounts but little information bearing upon the subject. From the pottery and other objects found in the ancient tombs and burial places, therefore, we have derived most of our knowledge of the musical instruments of the Incas, and the present discussion is based upon a study of the prehistoric Peruvian collections in the American Museum of Natural History. In these collections there are not only many of the musical instruments themselves, but also artifacts, principally pottery vessels, decorated with figures of men in the act of playing upon such instruments.

It is commonly said that "Peru is a puzzle"; and certainly this may be truthfully said of its music. Although we find recorded a number of characteristic songs, known to the Peruvian Indians for nearly two hundred years, we cannot say positively of any one of them that it is wholly pre-Spanish. Dr. von

[1] Royal Commentaries of Peru. Ed. Rycaut, Part I, Book I, Chap. III.

[2] Conquest of Peru, Vol. I, p. 28.

Tschudi has published three Peruvian elegiac songs or *haravis* [1] which he says "might serve to test the musical knowledge of the ancient Peruvians," but an examination of these pieces is very disappointing. Carl Engel remarks:

"At all events they must have been tampered with, as they exhibit exactly the form of the Spanish *bolero*. Even allowing that the melodies of these compositions have been derived from Peruvian *haravis*, it is impossible to determine with any degree of certainty how much in them has been retained of the original tunes, and how much has been supplied besides the harmony, which is entirely an addition of the European arranger." [2]

The first and simplest element of music is rhythm, and in singing or dancing a desire for some sound that shall clearly mark it is universal; hence, in the absence of musical instruments, the custom of snapping the fingers, clapping the hands, beating the hips and stamping the feet; and I am inclined to follow Rowbotham [3] in believing that the art of instrumental music in prehistoric times passed through three stages, which may be designated the "drum" type, the "pipe" type, and the "lyre" type. The first type includes all instruments of percussion, as drums, rattles, gongs, castanets, etc.; the second, all wind instruments, and the third, all stringed instruments. In support of this theory he cites the evidence furnished by the mechanical complexity of the instruments themselves. The drum is the simplest form; the pipe is more complex than the drum; and the lyre, which makes use of stretched strings, is the most complex of all.

That the drum was the first instrument of primitive man is strenuously opposed by Wallaschek, who says:

"The most ancient discoveries (from the youth of mankind) of flutes and pipes, but not of drums, are definite facts which no speculation can put aside, and I am rather inclined to believe that Wagener was correct in saying that a wind instrument was undoubtedly the first." [4]

[1] Antigüedades Peruanas, pp. 135, 136.
[2] Musical Instruments, p. 79.
[3] Journal Anthro. Institute Gr. Brit. and Ireland, Vol. X, pp. 380–381.
[4] Primitive Music, p. 84.

The entire absence of drums and the large number of flutes in the prehistoric Peruvian collections in museums would seem to support this claim in Peru were it not for the fact that numerous pottery vessels decorated with figures in the act of beating the drum are found with mummies in the ancient graves. (See Plates I and II.)

The fact that a tribe has flutes and no drums is not proof that their earliest instrument was not the drum. There are well-known cases of the "dropping out" of musical instruments. In Guatemala the *marimba* has become a national instrument. Professor O. T. Mason, referring to this instrument, says:

> "In one case we have a musical instrument imported by negro slaves given to the Indians with its native African name and abandoned by the negroes themselves." [1]

INSTRUMENTS OF PERCUSSION.

Drum

In instruments of this class the drum undoubtedly held the first place, although, as has been stated, none has been found in the ancient graves up to the present time. This may be accounted for by the perishable material of which they were made; or, through the existence of some superstition on account of which they may never have been buried with the dead. However this may be, the numerous representations on pottery vessels, and the accounts of early writers, give us a pretty accurate idea of their form and construction.

The drums appear to be identical with those in use in many parts of Peru to-day and were made by stretching a skin over a hoop of wood or over one end of a short section of the trunk of a tree which had been hollowed out to a thin cylinder. These two forms of drum are shown on Plate II, where two men (figs. 7 and 10) are beating very thin drums, which would seem to represent the hoop form, while another drummer (fig. 9) plays upon one much thicker, which is probably of the second type. Judging from these representations, the drums would not exceed fourteen or fifteen inches in diameter. We are told frequently by early writers that small drums were used on different occasions; but

[1] American Anthropologist, Vol. X, No. 11.

no mention of larger ones, so common in many Indian tribes, has been found. The Abbé Molina, describing the method of curing the sick, says:

"The *Machi* directs the women who are present to sing with a loud voice a doleful song, accompanied with the sound of some little drums, which they beat at the same time." [1]

Doubtless the heads of these drums were usually made of the skin of the deer and other animals common to the country, but this was not always the case. The Huancas "flayed the captives they took in war, making some of the skins into drums." [2] Garcilasso says:

"They were a sort of fierce and warlike people fleaing those whom they took in the wars, the skins of which they filled with ashes and hanged them up in the temples for trophies; with the skins of some they make drums, being of opinion that the sound of them would terrify their enemies." [3]

Copper bells, in form resembling our sleigh-bells, appear to have been in common use. Figs. 2, 3, and 4 of Plate II show three, each of which has a pebble in the cavity. Fig. 1 shows a flattened form, decorated on either side with a figure, probably representing the sun. This bell has been broken, and the pebble or "clapper" is missing. Cieza de Leon, who is perhaps the most reliable of the contemporaneous writers, remarks:

Bell

"When the chiefs [Guayaquil, Ecuador] were sick, to appease the wrath of their gods, and pray for health, they made other sacrifices of a superstitious nature; killing men (as I was told), and believing that human blood was a grateful offering. In doing these things they sounded drums and bells before certain idols shaped like lions and tigers, which they worshipped." [4]

In the Museum collection there are three bronze objects, circular in outline and slightly concavo-convex, each having a

[1] History of Chili, p. 92.
[2] Travels of Cieza de Leon, Ed. Hakluyt, Part I, p. 299.
[3] Royal Commentaries of Peru, Ed. Rycaut, Part I, Book VI, Chap. X.
[4] Travels of Cieza de Leon, Ed. Hakluyt, Part I, p. 203.

PLATE II

projection perforated for suspension. When struck with any hard substance, they give out a remarkably clear and resonant sound. One of these is shown as fig. 12 of Plate II. It is three and seven-eighths inches in diameter. Ewbank, describing Señor Barboza's collection of Peruvian antiquities, figures three of these objects, two of which he states are of copper and one of bronze. He says: "I took them for mirrors; but they do not seem to have been polished."[1] None of the three in the Museum shows any indication, on either side, of having been polished, and there seems to be no reason to doubt that they were used as gongs or bells.

Rattle and Cymbal

Of the various forms of rattles it is hardly necessary to speak in detail. They consisted of small shells and nuts, seeds of a species of laurel tree, etc., and were often strung together. (See Plate II, fig. 8 and Plate III, figs. 5, 7, 8.) These were attached to the wrists, ankles and other parts of the body in dancing. A common form of rattle was a gourd containing seeds or pebbles. The use of shells as paint cups or palettes was very common, as is attested by numerous specimens, which still contain paint, found in graves; but their use as musical instruments in ancient Peru, has not been noticed before. Figs. 5 and 6 of Plate II represent water vessels of terra cotta, decorated with figures striking shells together, as cymbals are played. The "cymbals" are so well modeled that there can be no doubt that they represent Spondylus (*Spondylus pictorum*, Chem.) shells. (See Plate II, fig. 11).

WIND INSTRUMENTS.

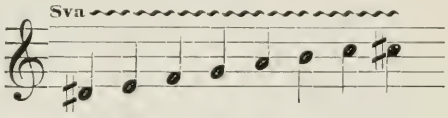
Syrinx or Pan-pipe

Long before the conquest the Peruvians had emerged from the first or drum stage, and reached the second, which C. K. Wead defines as that "having instruments mechanically capable of furnishing a scale"[2]—a tremendous stride in the art. The most important instruments of this class are the syrinx or Pan-pipe (*huayra puhura*) and the flutes of bone and cane. Fig. 7 of Plate IV shows a syrinx

[1] Life in Brazil, Appendix, p. 454.

[2] Contrib. to the Hist. of Musical Scales, Rep. U. S. Nat. Mus., 1900, p. 421.

consisting of eight reeds of graduated lengths, held in position by a crosspiece of split cane lashed to the reeds with a cord made of the wool of the llama. This pipe has all the reeds open at the lower ends, and yields the following scale:



Other Pan-pipes are found with reeds closed at the lower end; and still another form has a double set of the same dimensions, —one set open at the bottom and the other closed, those of corresponding length being placed opposite each other. By this arrangement octaves are produced, the closing of a pipe at one end, as is well known, lowering its pitch an octave. This same law is utilized by the modern organ builder in the employment of the so-called open and stopped diapasons.

A curious and unique syrinx of stone is shown as fig. 3 of Plate III. The illustration is made from a plaster cast. The original, which was procured by the French general Paroissien, is made of greenish talc, and is said to have been found on a mummy in a Peruvian tomb. This interesting specimen has been described at length by Carl Engel.[1] Figs. 1 and 2 of Plate IV represent water jars, in human form, made of terra cotta; both figures are represented in the act of playing the Pan-pipes. Garcilasso says:

"In music they arrived to a certain harmony, in which the Indians of Colla did more particularly excel, having been the inventors of a certain pipe made of canes glued together, every one of which having a different note of higher and lower, in the manner of organs, made a pleasing music by the dissonancy of sounds: treble, tenor and bass, exactly corresponding and answering each to other; with these pipes they often played in consort, and made tolerable music, though they wanted the quavers, semiquavers, airs, and many voices which perfect the harmony amongst us." [2]

These pipes are as popular with the modern Indians as they

[1] Musical Instruments, p. 66.

[2] Royal Commentaries of Peru, Ed. Rycaut, Part I, Book II, Chap. XIV.

were with their ancestors in the days of the Incas. Indian couriers frequently use this instrument to announce their arrival and departure, as the post-horn was used by the driver or guard of a mail coach in England, and as it is now used by a New York coaching party.

E. G. Squier, who witnessed the *chuño* or potato festival of the Aymará Indians, says:

"Each group danced vigorously to its united music, which made up in volume what it lacked in melody—wild and piercing, yet lugubrious: the shrill pipe [Pan-pipe] and the dull drum, with frequent blasts on cow's horns by amateurs among the spectators, filled the ear with discordant sounds. Every man seemed anxious to excel his neighbor in the energy of his movements, which were often extravagant; but the motions of the women were slow and stately. The music had its cadences, and its emphatic parts were marked by corresponding emphatic movements in the dance. The 'devilish music' that Cortez heard after his first repulse before Mexico, lasting the livelong night, and which curdled his blood with horror, while his captured companions were sacrificed to Huitzlipochtli, the Aztec war-god, could not be stranger or more fascinating, more weird or savage, than that which rung in our ears during the rest of our stay in Tiahuanaco." [1]

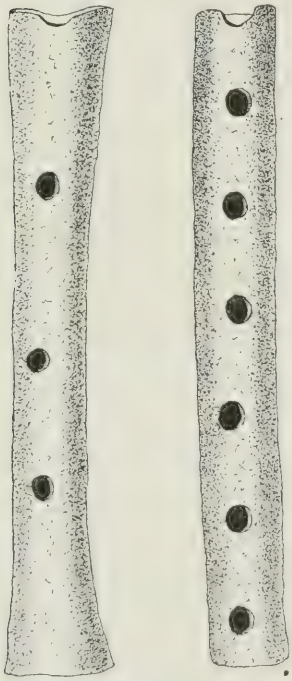
Lieut. Gibbon describes the "church performances" of the Aymará Indians thus:

"The wind-instruments are made of a succession of reeds of different sizes and lengths [Pan-pipes], upon which they blow a noise, little resembling music to our ear, keeping time with the drummers, the slow-motioned dancers respecting them both. . . . The women again appeared, each bringing with her a jar of *chicha*, which they served out in cups, giving to each individual as much as he could drink, which was no small quantity, for the morning was cold. The music again struck up, and the women again joined in the dance. One of them came out with her sleeping 'wawa' slung to her back, which soon commenced a laughable discord; but not a smile could be discovered in any of their faces; neither did the woman stop till the dance was ended." [2]

[1] Travel and Exploration in the Land of the Incas, pp. 306, 307.

[2] Exploration of the Valley of the Amazon, Part II, pp. 117, 118.

Bearing this description in mind, it will be interesting to turn to Plate I, fig. 2, which represents figures of men and women in relief, forming a band around a pottery water vessel. There is every reason to believe that the potter who moulded these figures was gathered to his fathers long before the coming of the Spaniards, yet he depicts the identical scene described by Lieut. Gibbon after so great a lapse of time; showing how such customs persist with these Indians. The musicians play upon Pan-pipes and the drum. The woman with her "wawa" (baby) strapped to her back is here, nor are the jars of chicha wanting. Chicha is a fermented drink made of maize, and is still the national drink of the Indians. J. S. Skinner relates that,



BONE FLUTES ¾

"In alternation of dancing, singing, and drinking they remain for several days and nights without intermission, until all the jars are empty. Father Figueroa pleasantly observes that he is at a loss to conjecture how they have a head for so much noise, a throat for so much exclamation, and a tooth for so much liquor." [1]

Flute

On Plate V, twenty-six flutes are represented. Nos. 1, 2 and 3 are of cane; Nos. 7, 8 and 9 are made from the wing bone (ulna) of the pelican; Nos. 11, 12, 14, 15 and 16 from combined ulna and radius of the llama; No. 13 is a small gourd. All the others are made from the ulnæ of deer. They are simply tubes, open throughout their length, and all belong to the class known as "end-blown."

In playing, the breath, crossing the opening at the upper end, impinges on the sharp edge, which is often notched, setting up vibration in the column of air within the instrument, thus producing the sound. It is a well-known law that the frequency of vibration,

[1] Present State of Peru, p. 290.

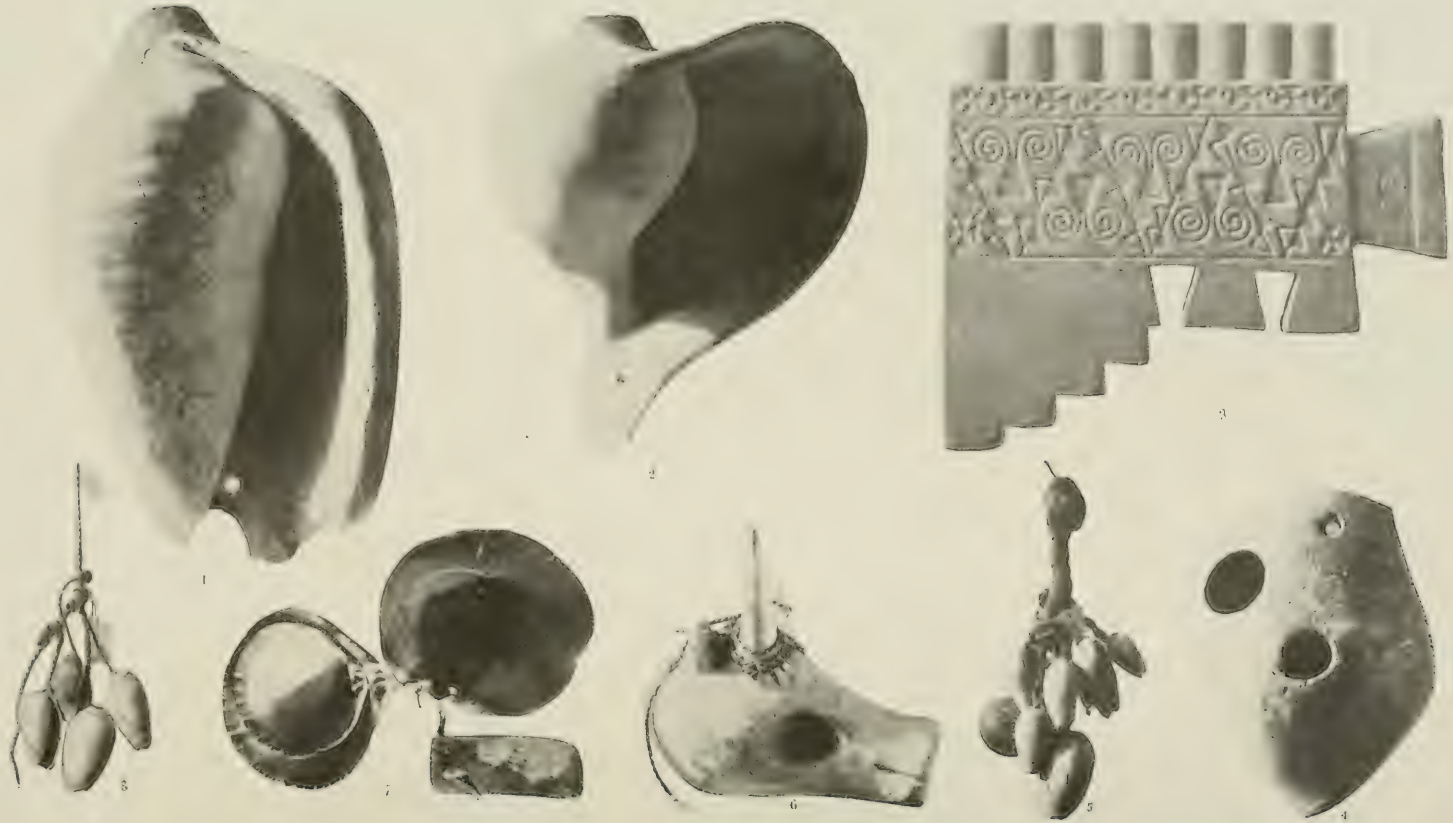


PLATE III "

or, in other words, the pitch of a note produced, depends chiefly on the length of the column of air within the flute.

In the flutes represented the vents or holes for changing the length of the vibrating column of air vary in number from three to seven. In those made of cane they are all on the upper side, while the bone flutes often have one of the holes on the under side, which was closed by the thumb. Nos. 4, 5, 6, 10, 11, 14 and 17 to 26 are of the latter kind.

All attempts to discover any rule or law governing the positions of the openings or vents have been unsuccessful. A first glance at several of these flutes, particularly those made of cane, gives the impression that an attempt at equal spacing had been made; but a second shows such a variation in distances that this seems doubtful. The bone flutes (figs. 25 and 26, Plate V) are of the same length, yet a great difference in the position of the holes is apparent at a glance. We are led to the conclusion that these ancient flute-makers were not governed by set laws, but that each made his instrument according to his own idea. That the tones produced are in false key-relationship is not to be wondered at when we consider the imperfections in their construction; in fact, the flutes are sadly out of tune. What the late John Comfort Fillmore wrote of the Omaha Indian flageolet applies equally to these flutes:

"The imperfections are plainly due to the limitations, not of the Indian's perception, so much as of his scientific knowledge. The flageolet is evidently built 'by guess,' and only remotely approximates to the Indian voice in accuracy of intonation." [1]

Those acquainted with the difficulties that beset the maker of a flute at the present day will see nothing strange in the lack of method in the location of the vents in the flutes of these ancient Peruvians. Mr. Wead remarks:

"In practice these holes never can open so freely to the outside air that the portion of the tube beyond them may be considered as removed (the possibility or necessity of cross-fingering proves this

[1] Omaha Indian Music, Alice C. Fletcher, Appendix, p. 73.

DESCRIPTIONS OF FLUTES REPRESENTED ON PLATE V.

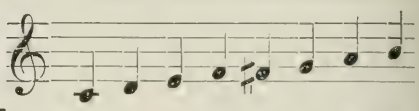
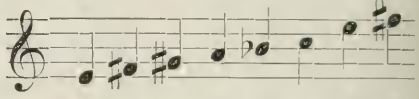
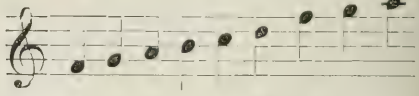
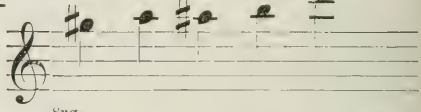
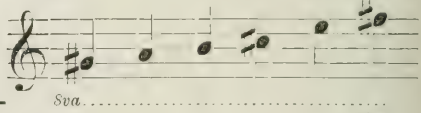
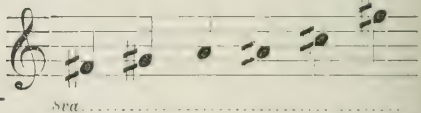
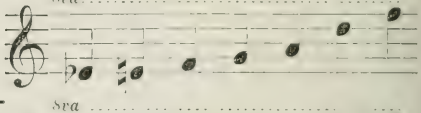
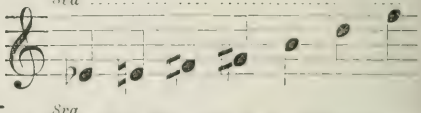
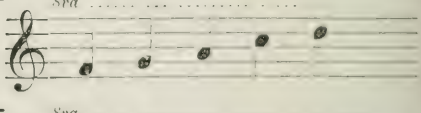
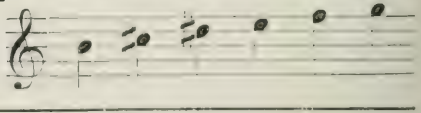
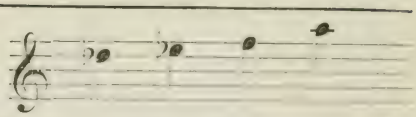
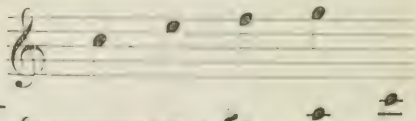
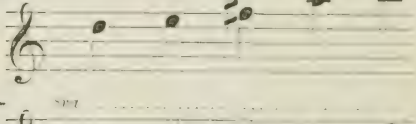
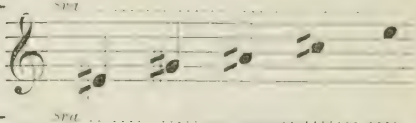
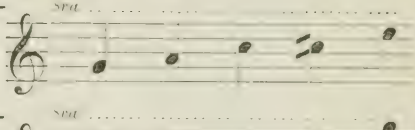
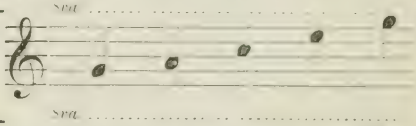
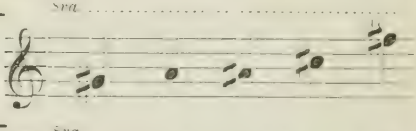
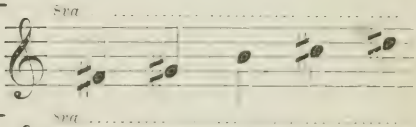
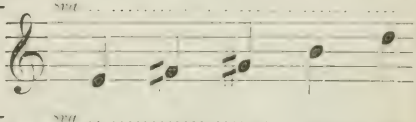
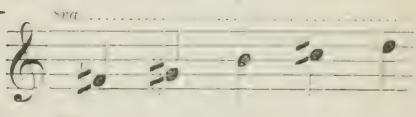
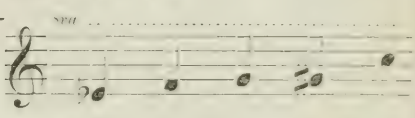
Figure.	Museum No.	Length in inches.	Material.	Scale.
1	B 3852	$15^{13}/_{16}$	Cane	
2	B 8139	$10^{1}/_{8}$	"	
3	B 8138	$9^{7}/_{8}$	"	
4	B 3509	$3^{7}/_{16}$	Bone	
5	B 382	4	"	
6	B 505^{B}	$4^{3}/_{8}$	"	
7	B 3848	5	"	
8	B 3846	$4^{9}/_{16}$	"	
9	B 3847	$4^{9}/_{16}$	"	
10	B 618	$6^{1}/_{4}$	"	
11	B 7945	$5^{1}/_{4}$	"	
12	B 7951	$7^{1}/_{8}$	"	

Figure.	Museum No.	Length in inches.	Material.	Scale.
13	B / 8013	3	Gourd	
14	B / 4929	$6\frac{1}{8}$	Bone	
15	B / 2648[4]	$6\frac{7}{8}$	"	
16	B / 2648[B]	8	"	
17	B / 7944	$6\frac{3}{4}$	"	
18	B / 7954	5	"	
19	B / 7955	$4\frac{1}{2}$	"	
20	B / 7948	$4\frac{1}{4}$	"	
21	B / 619	4	"	
22	B / 7949	$5\frac{3}{8}$	"	
23	B / 505[4]	$4\frac{5}{8}$	"	
24	B / 7946	6	"	
25	B / 505[C]	$5\frac{1}{4}$	"	
26	B / 750	$5\frac{1}{4}$	"	

to the player), so the proper location and diameter of the holes to produce the notes of our scale of even quality are fixed, not by a simple law, as the frets on the guitar are located, but by laborious experimenting to get a standard instrument which is then reproduced with Chinese fidelity." [1]

The question arises, Were the intervals produced on these flutes satisfactory to the Indian? That the first attempt was not so in very many cases, we know from the indisputable evidence of his work. Fig. 4 of Plate V shows the under side of a flute. It will be seen that the original thumb hole has been closed (by a stopper made of gourd) and another perforated above it. No. 7 has had four of the six original holes plugged and others bored near them,—only traces of the gourd plugs remaining. No. 17 shows plainly the plug in the original hole, and the vent which was afterward made above it. No. 19 shows two sets of holes. Of the plugs, only traces remain; but the one in the under side (thumb hole) is still in as perfect condition as those to be seen in figs. 17 and 21. In No. 20 they have entirely disappeared. The scales of the twenty-six flutes shown on Plate V are given on pages 18 and 19. They have been carefully determined in conformity with the international pitch: vibration-number $a^1 = 435$.

Many of the tones produced from these instruments only approximate, in pitch, to some one of the notes of our familiar twelve-tone piano scale. In many instances the variation amounts to nearly a quarter of a tone. Considering the age and condition of these flutes, it is safe to say that in some cases the scales given here are incomplete, and this applies particularly to those made of cane.

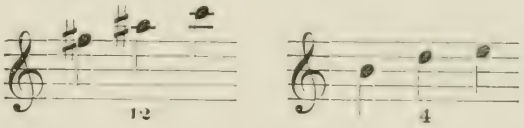
No. 14 of this set appears much longer than it really is,—the bird figures being carved on a prolongation of one side of the bone, below the tube.

Nos. 4, 11 and 12, represented on Plate IV, may be classed with the flutes. No. 12 is made from a shell (*Fasciolaria princeps*, Sowb.). It has two vents: one perforated through the top of the spire, the other in its side. No. 4 is an imitation of a shell in terra cotta. It is decorated with a human face and

[1] Contrib. to the Hist. of Musical Scales, Rep. U. S. Nat. Mus., 1900, p. 426.

PLATE IV

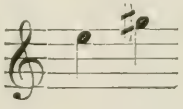
geometrical designs, which are not shown in the illustration. The scales of these flutes are given below:



No. 11, also of terra cotta, is broken and the scale cannot be ascertained. These instruments are sounded by the breath impinging on the sharp edge of the outer lip of the shell.

Whistles of the resonator class have a wide distribution and have been found in different sections of Peru. They are usually made of terra cotta, but sometimes of other materials. The kind most commonly met with emit but one or two tones and generally go by the name of "signal whistles" or "bird-calls." The resonator type reached its highest form of development in Chiriqui and parts of Central America, where they commonly took the human form or that of some well-known animal or bird, and in most cases the grotesque element predominated in the representation. The openings (vents) to the air chamber in the body of these instruments vary in number, but seldom exceed four. On Plate IV, figure 13 shows an instrument of this class. This specimen is one and three-eighths inches high, and measures two and three-quarters inches from the nose to the tip of the tail. Its two vents are on the same side, yielding the following scale:

Resonator Whistle

No. 15, on the same plate, is of wood and has one vent. Its tones are:

No. 6, on Plate III, and Nos. 8, 10, and 14 on Plate IV, are without vents and have but one note each.

Whymper, who gives an excellent account of the Incan remains in Ecuador, figures three of these whistles grotesquely resembling the human form. He has this to say of them:

"Then there are the musical pottery whistles, delightfully ugly things, which are sometimes more useful to carry than letters of introduction. Simple airs can be got out of them, and on the homeward journey my people lightened the way by playing on these primitive instruments." [1]

GOLD ORNAMENT FROM ICA, PERU. ½

Trumpet

The trumpet in its various forms is undoubtedly one of the most ancient of wind instruments, and its distribution in prehistoric times was all but universal. Two forms of this instrument were common in Peru: the conch and a trumpet of terra cotta. Both of these forms are shown in the accompanying figure.

This illustration shows the ornamentation on one side of a gold ornament found in a prehistoric grave at Ica, Peru. It is double-convex in form, consisting of two thin, concavo-convex pieces which are not joined by solder, as is sometimes the case in ornaments of this kind, but are held together by the edges of one of the pieces being turned tightly over the other. The figures are in *repoussé* work.

Fig. 1 of Plate III represents a remarkably fine specimen of the shell trumpet. It has a copper mouth-piece, and is ornamented with an engraved figure of a warrior. The shell is a *Strombus galeatus*, Swains. Unfortunately the mouth-piece

[1] Travels amongst the Great Andes of the Equator, p. 281.

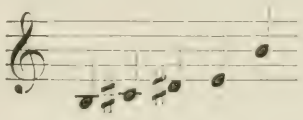
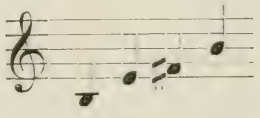
is so badly corroded that the scale of the instrument cannot be ascertained. Fig. 2, on the same plate, is of a trumpet of terra cotta, and is one of several in the collection in which the shell form has been reproduced in clay. It would seem that this was frequently done when shells could not be obtained. This specimen is in perfect condition. Its scale is as follows:

The lowest or fundamental tone is produced on the open instrument; the next step above in the scale, by introducing the hand a short distance into the opening of the "shell." For the next higher note the hand is pushed still farther into the cavity, and so on until the highest tone of the instrument is reached. In the older natural or French horn, the so-called stopped tones are obtained in much the same way.

Fig. 9 of Plate IV represents a clay trumpet similar to that represented on the gold ornament from Ica figured on page 24; the only difference is the shape of the "bell," which in the latter takes the form of an animal's head. Besides its fundamental tone (B), only its octave can be produced. The other harmonics or overtones, on account of the material and its faulty construction, are absent. Nos. 5 and 6, on the same plate, are trumpets of wood. The mouth-pieces are shallow and cup-shaped, as in No. 9, just described. No. 6 is badly cracked; but No. 5 is entire, and the following tones can be produced from it:



The trumpet is frequently mentioned in the early accounts of Peru. Garcilasso, giving an account of the battle between the army of the Inca Viracocha and the Chancas, says:

"Both armies remained the whole night upon their guard with

sentinels set on each side; and in the morning, by break of day the squadrons arming themselves, with great noise and shouts, with sounds of trumpets, and timbrels, and cornets, they began the onset." [1]

Alonso de Ovalle remarks:

"The sound of the drum and trumpet is only to show them the necessity of their meeting in arms." [2]

Prescott tells us that at the siege of Cuzco (1536)

"The Spaniards were roused by the hideous clamor of conch, trumpet and atabal, mingled with fierce war-cries of the barbarians." [3]

Double Whistling Jar

Fig. 3 of Plate IV shows a double musical water bottle. It consists of two pottery vessels connected near the bottom in such a way that water passes freely from one to the other. Near the top of the first or front jar (usually surmounted by a human or some animal figure) is the opening of the whistle. When the jars have been partly filled and are swung backward and forward, a series of whistling sounds is produced. As the vessel swings forward and upward, the water is lowered in the first jar and raised in the other; in the backward motion it rushes back into the first, forcing the air out through the whistle. It has often been said that the sound emitted by these jars resembles the cry of the animal represented on the vessel. A careful examination of fifty-five of these whistling jars leads to the conclusion that this is the result of a lively imagination—that they are whistles pure and simple.

Fig. 4 of Plate III shows a nondescript instrument made of terra cotta. The tone is produced by blowing into either of the two holes in exactly the same manner that the trumpet is sounded. The lips, in both cases, act as reeds, causing the vibration of the air within the instrument.

[1] Royal Commentaries of Peru, Ed. Rycaut, Part I, Book V, Chap. XVIII.
[2] Historical Relation of Chile, Pinkerton, Vol. XIV, p. 122.
[3] Conquest of Peru. Vol. II, p. 47.

PLATE V

Cornets were used by the Inca's army at the siege of Cuzco. Formerly this name was given to a rude reed instrument of the oboe family, and it is probable that it was similar to those still used in a number of tribes in the Amazon region: a piece of cane from two to five feet long, with one end closed by some gummy substance, through which is passed a split quill which forms the "reed." Herrera tells us that Orellana, on his voyage down the Amazon (1540–1541), was pursued by 130 canoes containing 8000 Indians, and that the noise of their drums, cornets and shouting was a thing frightful to hear.[1]

Cornet

STRINGED INSTRUMENTS.

A NUMBER of modern writers have stated that the *tinya*, a kind of guitar with five strings, was known to the Peruvians in pre-Spanish times. This seems as improbable as Rankin's story of fiddlers being attached to the court of Montezuma.[2] Garcilasso de la Vega, in his chapter entitled "Of the Geometry, Geography, Arithmetick and Musick known to the Indians," gives no account of any stringed instrument.[3] There is scarcely a chapter in the "Cronica del Peru" of Cieza de Leon that does not contain mention of some musical instrument, but we find no hint of instruments of this class. The Peruvians themselves, as we have seen, left behind them many of their instruments and numerous representations of them on their pottery vessels and metal ornaments; but among them all, not one belonging to the lyre type can be found. Professor O. T. Mason says:

"After looking over the musical collection of the United States National Museum and such literature as has been collected by the Bureau of American Ethnology, I have come to the conclusion that stringed musical instruments were not known to any of the aborigines of the Western Hemisphere before Columbus."[4]

[1] Voyage of Francisco de Orellana, Ed. Hakluyt, p. 29.
[2] Conquest of Peru and Mexico by the Mongols, p. 344.
[3] Royal Commentaries of Peru, Ed. Rycaut, Part I, Book II, Chap. XIV.
[4] American Anthropologist, Vol. X, No. 11, 1897.

Professor E. S. Morse agrees with Dr. Mason that there is no evidence of a pre-Columbian stringed device. [1]

I believe that no claim has as yet been made for the existence of the musical bow in Peru; and what Dr. Henry Balfour says of this most primitive of stringed instruments is very important, as showing with what caution the evidence should be considered before pronouncing any instrument to be of pre-Spanish origin:

"In viewing the various types of musical bow to be found in the New World, I must say that I feel that the case of the claims of this instrument to be regarded as indigenous (pre-Columbian) in the Americas can only as yet be dismissed with the verdict of *not proven*. I can find no absolutely convincing evidence to prove the case, and in view of the certainty of many varieties having been introduced by the immigrants from Africa, it will require very strong evidence to establish the claim." [2]

Although not conclusive, such evidence as we have at the present time is against the existence of any form of stringed instrument in Peru before the coming of the Spaniards.

CONCLUSION.

Undoubtedly the most important instruments were the drum, the various kinds of flutes and the Pan-pipe. Early writers frequently speak of the Indians dancing to the music of the pipe and tabor. The ancient potters have left us representations of these scenes on their water vessels (Plate I, figs. 1 and 2). These dances appear to have remained unchanged in 1649 when Alonso de Ovalle wrote this quaint account:

"Their way of dancing is with little jumps, and a step or two, not rising much from the ground, and without any capers such as the Spanish use; they dance all together in a ring." [3]

Of the music of the Incas we know nothing. A number of songs have been recorded which have been known to the Indians for generations, and believed by them to have been handed down unchanged, but their authenticity is, of course, doubtful—even

[1] Appleton's Popular Science Monthly, March, 1899.
[2] The Natural History of the Musical Bow, pp. 50–51.
[3] Historical Relation of Chile, Pinkerton, Vol. XIV, p. 117.

the source from which they came being uncertain. Negroes were introduced early into all the Spanish colonies, and doubtless many of their tunes were adopted by the Indians. Garcilasso tells us that when he left Peru in 1560 there were then five Indians residing in Cuzco who were great masters on the flute, and could play readily, by book, any tune that was laid before them.[1] In view of these conditions, we may well be sceptical concerning the claims of any music said to be pre-Spanish.

We now come to that much vexed question, What musical scale was known to the ancient Peruvians? In the absence of any authentic music we must look to their instruments as the only source of information. It has been believed commonly that they employed the five-toned or pentatonic scale, so widely used in the primitive music of various peoples, which one of our most eminent musical scholars and critics insists "represents a stage in musical development and is neither a racial nor geographical indication."[2] In this scale the step of a semitone is avoided by omitting the fourth and seventh degrees in major and the second and sixth in minor.

Many of the scales given in this paper seem to indicate the use of this five-toned scale, but there are some puzzling exceptions. Hitherto but few scales of Peruvian instruments have been published. When a sufficient number has been collected, it may be possible to determine the intervals of the Peruvian scale.

[1] Royal Commentaries of Peru, Ed. Rycaut, Part I, Book II, Chap. XIV.
[2] H. E. Krehbiel in *New York Tribune*, Sept. 8, 1901.

JESUP NORTH PACIFIC EXPEDITION—FIELD OF OPERATIONS

The American Museum Journal

VOL. III. OCTOBER, 1903 No. 5

FOR many years the American Museum of Natural History has had before it the investigation of the life of man on this continent, and since 1897 the larger question of the tribal relations between the early inhabitants of America and those of Asia. Much time and labor have been devoted to these researches, the most important of which have been included in the work of the Jesup North Pacific Expedition. This enterprise has aroused public interest to such an extent and evoked so many inquiries from all parts of the world that it has been deemed best to give a brief résumé of the history of its organization and of the field work which has been carried out by it. The résumé, which is published in this number of the JOURNAL, has been prepared by Professor Boas, to whom President Jesup intrusted the planning and direction of the whole expedition. It is not easy to find men of science fully qualified for such technical lines of research, and though the personnel of the different parties carrying on the work is given in the narrative, it will not be out of place to state regarding the men engaged to prosecute the investigations in Siberia that Dr. Laufer was recommended to the Museum by the Academy of Sciences at Berlin as a man amply equipped for work in this territory, while Messrs. Jochelson and Bogoras bore the highest testimony from both that Academy and the Imperial Academy of Sciences at St. Petersburg. With such men, the Museum felt that whatever the final results might be, it certainly had placed its interests in worthy hands. The list of papers that have been published gives some idea of what has been accomplished already. It is estimated that the completed series of scientific reports resulting from this expedition will fill at least twelve quarto volumes.

The readers of the JOURNAL may be interested in the inner

history of an incident connected with the organization of the Expedition which is barely touched upon in the narrative. The incident, furthermore, shows the friendly feeling of the Russian Government toward the United States and links the Museum with the educational work and policy of the Czar. Dr. Laufer's home was in Cologne, Germany, but he came to New York *en route* to the Amur River region by way of Vancouver. It was necessary to have his passport *viséed* by the Russian Consul General in New York before he could enter Siberia, but that official refused to give his certification. President Jesup carried the matter to the Russian Ambassador at Washington, who, however, declined to reverse the ruling. The Department of State at Washington then was asked to intercede with the Russian government through Mr. E. A. Hitchcock, the United States Ambassador at St. Petersburg, but the Russian Minister of the Interior declined to interfere in the matter. Then were enlisted the good offices of Professor Radloff, Director of the Ethnographical Museum in St. Petersburg and also a prominent member of the Imperial Academy of Sciences, and through him the matter was brought to the personal notice of the Grand Duke Constantine Constantinovitch, President of the Academy, who conveyed President Jesup's request directly to Emperor Nicholas II. His Imperial Majesty overruled the preceding decisions and granted Dr. Laufer permission to carry on the proposed investigations "as an act of courtesy to the Government of the United States, as well as in the interests of ethnological research."

The Guide Leaflet issued with this number of the JOURNAL is a general introduction to the study of the collections on exhibition in the halls of the Department of Vertebrate Palæontology. During the past summer the exhibition collections of this department have been entirely rearranged and have been brought into accord with the advances made in the science up to the present time. This has rendered necessary the entire re-writing of the Guide Leaflet which was issued in January, 1902. Guide Leaflets to special portions of the exhibit have been prepared or are in course of preparation. One of the series, that on the Evolution of the Horse, was issued in January, 1903.

ROUTE-MAP, JESUP NORTH PACIFIC EXPEDITION

The red lines show the principal routes traversed by the parties in the field from 1897 to 1902 inclusive. In North America the journeys of the different parties have not been indicated separately, the country having been covered in so many directions: in Asia the dot-and-dash line shows the course followed by the Bogoras party; the broken line, that of the Jochelson party; the solid line, that of the Laufer party.

THE JESUP NORTH PACIFIC EXPEDITION.

AMONG the great problems of anthropology, the one which stands out as of particular interest and importance to the American people is the problem of the earliest history of the native races of our continent and their relation to the races of the Old World. Questions relating to this problem have been the subject of much speculation, particularly in our own country. While the science of anthropology was still in its infancy, the flight of imagination carried away investigators and led them to identify the American race with one or another ancient people of the Old World. Later a reaction set in, which culminated in the view of Dr. D. G. Brinton, who considered the American race and American culture as entirely independent of those of the Old World. This view, however, seems to be too extreme to be tenable. The question of the relation between the people of the Old World and those of the New may be stated in the following manner:

There is little doubt that the American race has inhabited our continent for a long time. Although no finds have been made that establish its geological antiquity beyond cavil, we have good reason to believe that man inhabited this continent at a very early time. The principal foundation for this belief is the existence of well-marked varieties of the American race, the establishment of which must have occupied a long period. The general characteristics of the race are fairly uniform. The smooth dark hair, broad heavy face, large nose and rather full mouth are common to all the natives of America. But nevertheless a number of distinct types have developed, differing in color of skin, in form of head and of face and in proportions of the body. The differences in these types show that much time was necessary for their development.

The long occupancy of our continent, which thus seems probable, implies that American culture passed through a long period of development. It is likely that the distinct types of the race developed in isolated spots, and therefore culture must also have followed distinct lines of growth.

This period, however, has long since passed. At the time when American tribes entered the field of our knowledge, and even in periods of which archæology alone gives evidence, contact had been established between the tribes of the north and of the south, of the east and of the west, so that it is no longer possible to consider as the product of isolation the cultural possessions of each tribe. Archæological evidence also shows that distinct types followed one another in the occupancy of each area. In short, changes of far-reaching importance took place long before the tribes became known to history. These changes imply mixture of blood as well as exchange of cultural achievement.

A systematic investigation of the question in how far American race and culture can be considered as independent must necessarily take up the study of those regions where the geographical connection between the Old World and the New is closest. One of these regions is the coast of the North Pacific Ocean; another is far to the south, where the wide scattering of the Polynesian people suggests the possibility that they also may have reached our continent. Of these two regions the northern one seemed to be more likely to give results. Here the geographical conditions favor migration along the coast-line and exchange of culture. Our knowledge of this area previous to the work of the Jesup Expedition indicated that manifold changes in the culture and location of the tribes inhabiting this area had taken place. The multiplicity of languages spoken along both coasts, and their division into numerous dialects; the great variety of types of the area, their irregular distribution and their affiliations with types of distant regions; the peculiar types of culture,—all indicate that the primitive tribes of the coast have passed through a long and varied history. The types of man which we find on the North Pacific coast of America, while distinctly American, show a great affinity to North Asiatic forms, and the question arises, whether this affinity is due to mixture, to migration or to gradual differentiation. The culture of the area shows many traits that suggest a common origin, and others that indicate diverse lines of development.

What relation these tribes bear to each other, and particularly

FORT RUPERT, VANCOUVER ISLAND

what influence the inhabitants of one continent may have exerted on those of the other, are problems of great magnitude, the solution of which lies in a careful study of the natives of the coast, past and present, with a view to discovering as much as possible of their history. These were the problems that attracted the attention of Morris K. Jesup, Esq., President of the American Museum of Natural History, and induced him to provide personally with great liberality the means for carrying on investigations.

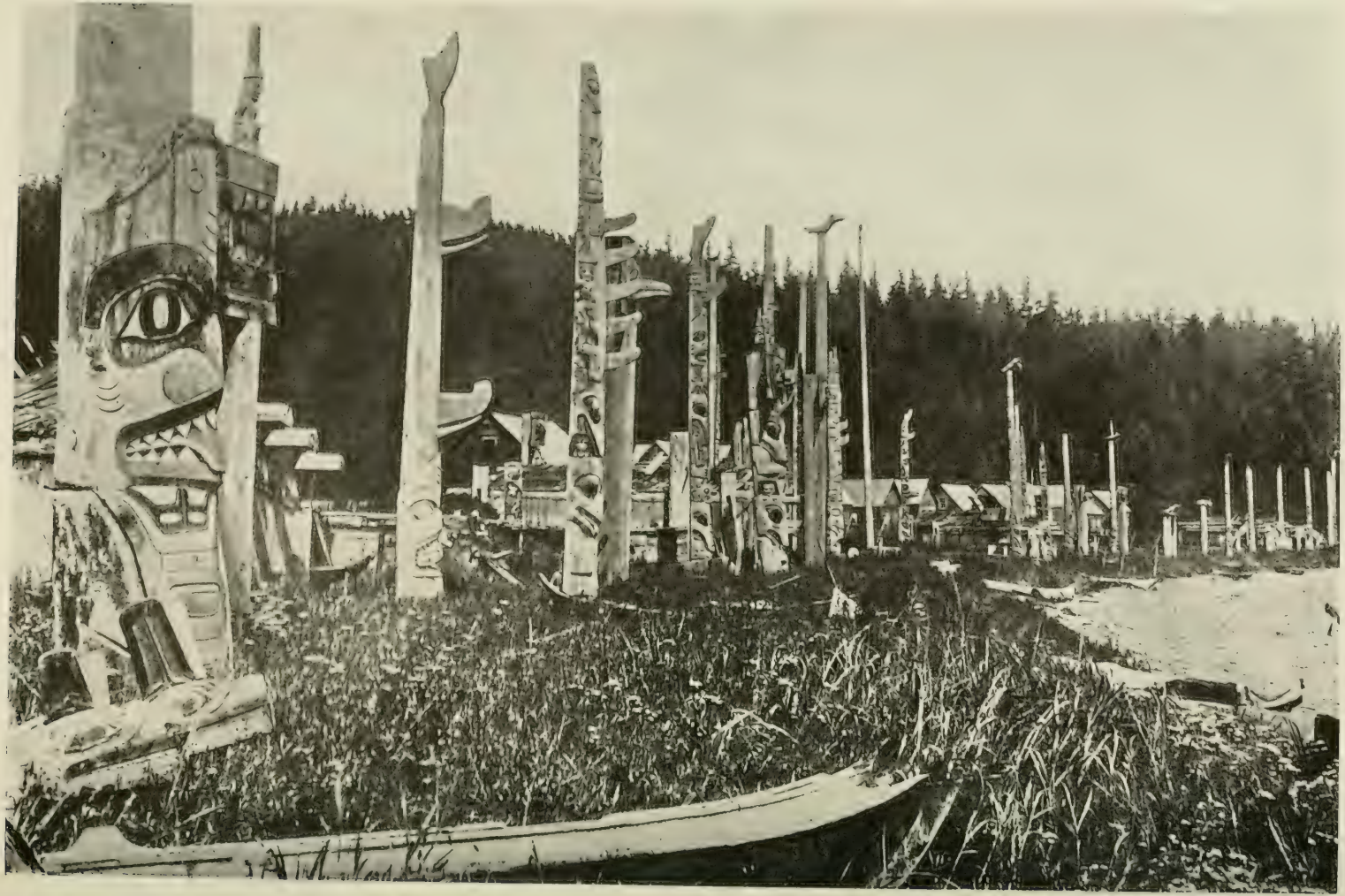
Since the ultimate conclusions of the expedition were to be based on detailed comparisons of the types of man, cultures and languages of the North Pacific coast, it was necessary to organize several expeditions to collect the required information. It seemed best to divide the area among specialists, each devoting his energies to a certain group of tribes. The amount of work to be done in both Siberia and America was very great, on account of the great differentiation of tribes. It therefore seemed necessary to set certain limits to the work of the expedition. In Asia the isolated tribes of northeastern Siberia were made the special subject of our studies, while in America the isolated tribes between Bering Strait and Columbia River were to be investigated. The problem to be solved in Asia was the relation of the isolated tribes of Siberia to the Turkish and Tungus tribes of that continent on the one hand, and to the isolated tribes of northwestern America on the other. In a similar way the problem in America was the relation of the coast tribes of the Northwest to the inland and southern tribes of our continent and to the Siberian tribes of the other.

The multiplicity of tribes in America is clearly shown on the map on page 68. Since the Eskimo of Alaska had been studied by Mr. E. W. Nelson for the United States Government, and since the Tlingit had been investigated by Lieut. G. T. Emmons, U. S. N., who it is hoped may publish the results of his researches, the principal work by the Jesup Expedition had to be done in British Columbia and the State of Washington. The most important topics to be studied were the eth-

nology of the coast of Washington, that of the Salish tribes of the interior and of the coast, that of the tribes of Vancouver Island and that of the Haida of Queen Charlotte Islands. At the same time archæological investigations had to be carried on in the whole region.

The party which carried on operations during the year 1897 consisted of Prof. Franz Boas of the American Museum of Natural History, Prof. Livingston Farrand of Columbia University, New York, and Mr. Harlan I. Smith of the American Museum of Natural History. This party was assisted in the field by Mr. James Teit of Spence's Bridge, B. C., Mr. George Hunt of Fort Rupert, B. C., and Mr. Fillip Jacobsen of Clayoquot, B. C. The New York party travelled westward by way of the Northern Pacific railroad, through the courtesy of whose officials the journey was rendered most pleasant. After having made the necessary preparations in Victoria, B. C., they proceeded to Spence's Bridge, where they arrived on the 2d of June, and were met there by Mr. Teit. The great familiarity with the language of this area which Mr. Teit had acquired during a long period of residence there, and the deep interest which he took in the Indians, made him a most valuable assistant in the investigations. Early in the year 1897 he collected notes on the Thompson River Indians for the use of the Jesup Expedition; and with his help a number of additional data were obtained, mainly bearing upon the art of the Indians, their language and their physical characteristics. While these investigations were being carried on, Mr. Smith made preparations for archæological investigations in the valley of the Thompson River.

It was soon found that Spence's Bridge was not the most favorable place for excavations; and for this reason Mr. Smith moved his base of operations, first to Kamloops and later to Lytton, which is situated at the confluence of the Fraser and Thompson Rivers. At Kamloops and Lytton, Mr. Smith conducted extensive excavations on the hillsides and in the valley, discovering numerous remains of previous habitations, some of which are without doubt of considerable antiquity. Almost all



HAIDA VILLAGE, QUEEN CHARLOTTE ISLAND

his finds antedate the advent of the whites and give us an excellent insight into the culture of the people at that period. Beautiful carvings in bone illustrate the high development of plastic art that had been attained by the Indians; shells from the seacoast indicate the existence of early intertribal trade, and numerous implements made of stone, bone and shell illustrate the general state of culture of the tribe.

While Mr. Smith was conducting his investigations at Kamloops, Professors Boas and Farrand, accompanied by Mr. Teit, started on a lengthy trip northward, which was intended to serve two purposes: to investigate the physical characteristics of the Indians inhabiting the banks of the Fraser River north of Lytton, and to study the customs and physical characteristics of the Chilcotin, the most southern Athapascan tribe of British Columbia. From Chilcotin it was intended to continue the journey over the mountains to the coast, in order to study the Bella Coola, an interesting tribe, whose customs and beliefs had never been subjected to systematic inquiry. The party started with a train of ten horses from Spence's Bridge and crossed the mountains to Lillooet on narrow trails. It was hoped that a considerable number of Indians would be met with in the high valley of Botani, where the tribes of Fraser River and Thompson River assemble every spring, but only comparatively few were encountered and the journey was continued after a short delay.

At Lillooet Professor Farrand separated from the main party and visited the villages of the Upper Lillooet on Seton and Anderson Lakes. Meanwhile the pack-train slowly proceeded along the wagon-road leading to Caribou. All the Indian villages that are situated on or near the wagon-road were visited, and a considerable number of anthropometric measurements were collected. After about a week Professor Farrand, who had completed his work among the Lillooet tribe, rejoined the party. On the 3d of July they reached Soda Creek, on Fraser River, the most northern village inhabited by the Shuswap tribe. Then they crossed the river and proceeded westward in order to visit the territory of the Chilcotin. After a few days the first village of this tribe was reached. The party proceeded slowly from

village to village until the most western Chilcotin village of any considerable size was reached. Now the further investigation of the interesting tribe was left to Professor Farrand, while Professor Boas proceeded on his journey across the mountains to Bella Coola.

The Chilcotin have been brought into contact with the whites in comparatively recent time, and, although they now live in log-cabins, raise cattle and horses, and till the soil, they are probably the most primitive among the tribes of British Columbia. A number of families still roam in the mountains between Lillooet and Chilcotin River, and have not been induced to settle on reservations; consequently the field of investigation was most interesting, and the results of Professor Farrand's ethnological inquiries are of great value. He spent most of his time in the larger villages of the Chilcotin; but during the month of August he visited the isolated families which live on the shores of Tatla Lake and in the mountains. From here he proceeded northward until the pass which leads to Bella Coola was reached.

Professor Boas followed the more northern route towards this pass, crossing the wild plateau north of Tatla Lake. On this journey a few of the Chilcotin who make their home near Lake Nakoontloon were encountered. From here there seems to be an enormous gap in the Coast Range, through which a trail leads westward, following a small river that takes its rise in the high mountains of the range. Gradually the valley narrows and the beautiful peaks and glaciers of the Coast Range come into view. The trail ascends higher and higher, until at a height of five thousand feet the summit is reached. Here a few small snow-fields have to be crossed and the trail suddenly emerges on the north side of Bella Coola River. The river is visible almost five thousand feet below; and on the opposite side of its deep and narrow valley rises the high peak, Nuskulst, which plays a most important part in the mythology of the Bella Coola. Enormous glaciers flank the sides of the mountain. A little farther down the river other snow-clad mountains of beautiful form come into view. In early times the villages of the Bella Coola were found all along the river, up to a place about twenty miles above

TSIMSHIAN

HAIDA

KWAKIUTL

NOOTKA

THOMPSON

QUINAULT

Nuskulst, but the tribe has so diminished in numbers that all the villages on the banks of the river have been abandoned. The trail descends the steep mountain-side until the river is reached, at a point about twenty-five miles above its mouth. Here the deep and rapid river had to be crossed. The party built a raft, on which an Indian embarked in order to fetch a canoe that was seen on the other side. In this the men crossed the river, while the horses swam over. Another day's journey brought the travellers to the village of the Bella Coola Indians. The road passes through a Norwegian settlement that has recently been established in this valley. At Bella Coola Professor Boas was met by Mr. Hunt, who, under special instructions, had collected valuable specimens among the Indians. The pack-train returned over the mountains to Fraser River, while Professor Boas staid among the Bella Coola Indians.

After obtaining much interesting information regarding the customs and beliefs of the Bella Coola, Professor Boas started down Bentinck Arm. Then he went by steamer northward to Skeena River, where he joined Mr. Smith, who had finished his work in the interior of British Columbia by the beginning of August. Some time was spent near the mouth of Skeena River in making investigations on the graphic art of the Haida Indians and in studying the physical appearance of the Tsimshian and Haida. Mr. Smith obtained a valuable series of photographs, while Professor Boas was engaged in making measurements of the people. By this time Professor Farrand had completed his work among the Chilcotin. Accompanied by an Indian, he crossed the mountains and at Bella Coola met Mr. Hunt, who was finishing his work in that tribe. Toward the end of August, both left Bella Coola to pay a visit to the village of Bella Bella, which is situated just outside the mouth of Bentinck Arm. Professor Farrand spent the remainder of the summer here studying the social organization and arts of this tribe, and Mr. Smith assisted him in the study of the physical appearance of the people.

After Professor Boas had completed his work on Skeena River, he journeyed southward on a coast steamer and was joined at Bella Bella by Mr. Smith and Mr. Hunt, while Professor

Farrand staid behind, continuing his investigations. The party landed in Rivers Inlet, where a stay of several weeks was made. Mr. Smith again assisted in the study of the physical appearance of the Indians, and after this work had been ended continued his journey to Vancouver, in order to resume his archæological investigations. Professor Boas and Mr. Hunt, who staid at Rivers Inlet, succeeded in collecting much interesting material on the language and customs of this little-known tribe. In the middle of September Professor Farrand joined them, having completed his work at Bella Bella. Soon afterward Mr. Hunt went to his home in Fort Rupert, while Professors Boas and Farrand returned to New York.

Mr. Smith, after going back to Vancouver, took up the investigation of the shell mounds at the mouth of Fraser River, which yielded important results, clearing up interesting points in the history of the Indians. It seems that the physical appearance of the Indians during the period of deposit of the shell mounds on Lower Fraser River had undergone material changes. The results that were obtained here were so important that it was necessary to continue the researches during the next year. When the rainy season set in, Mr. Smith moved his camp to southeastern Vancouver Island, where he spent some time in the investigation of prehistoric stone monuments. Finally, in the middle of November, the winter rains set in, which compelled him to conclude his operations.

During the summer Mr. Fillip Jacobsen undertook to make a collection illustrating the culture of the tribes of the west coast of Vancouver Island. His intimate acquaintance with the Indians and his varied experience in ethnological work made his assistance of great value. The expedition is also under great obligations to Dr. Charles F. Newcombe, who contributed an interesting collection from Queen Charlotte Islands.

In the summer of 1898 work in the State of Washington was begun by Professor Farrand and Mr. Smith. The isolated character of the coast-line between Grey's Harbor and Cape Flattery had subjected the Indians who inhabit it to less white influence than most of the Pacific tribes, and rendered their investiga-

GILYAK HOUSE, AMUR RIVER, SIBERIA

tion of particular interest. The region also formed a geographical link between the Vancouver Island and British Columbia stocks on the north and the Chinook on the south, both of which had previously been visited and studied, and had disclosed a number of problems with reference to the cultural relations between them which demanded the filling out of the gap. The territory in question is occupied by two tribes — the Quilleute on the north and the Quinault on the south; the former now the sole representative of the Chimakuan stock, and the latter one of the southern representatives of the Salish group. Professor Farrand first visited the Quilleute, reaching their village by way of the Strait of Juan de Fuca and an overland trail from Clallam to Lapush on the coast. Unfortunately, he found upon his arrival that almost the entire tribe had scattered for the summer salmon-fisheries, and it was impossible to procure the casts and records which were desired, but he remained for some days collecting such information regarding customs and folk-lore as was possible and preparing for a second visit later in the season. He then pushed on to the Quinault, where he had been preceded by Dr. Roland B. Dixon, who had been occupied in making casts of those Indians, and who, shortly after Professor Farrand's arrival, proceeded to the mouth of Fraser River to carry on his work there. Professor Farrand remained at the Quinault agency for nearly two months, engaged in making general ethnological and linguistic observations, and met with gratifying success. Toward the end of the summer he returned to the Quilleute, and, while still unable to find more than a few individuals of the tribe, collected some linguistic and other ethnological material of interest. The general results of the work show very clearly the gradual merging of the culture of the Northwest into the more southerly type. This merging is particularly observable in the mythology of the tribes.

In the summer of 1898 Mr. James Teit paid a prolonged visit to the Lillooet tribe, which is located in the mountains north of the Fraser River delta. He entered the territory of the tribe from the north and visited all their villages. The Lillooet were found to be of particular interest, because they form a link be-

tween the coast tribes and those of the interior. Dr. Dixon and Mr. Smith entered the Lillooet territory at the same time from the south. On this trip Dr. Dixon collected a number of photographs and plaster casts illustrating the types of this region, while Mr. Smith made a number of excavations at ancient village sites. In the same year Mr. George Hunt continued his collections among the Kwakiutl of Vancouver Island, a tribe with whose language he is thoroughly familiar.

Mr. Smith spent the greater part of the summer excavating in the shell mounds of Puget Sound and of the west coast of Washington. The results of his excavations show that there was a gradual merging of the ancient culture of this area into that of the Columbia valley, thus agreeing with the ethnological results obtained by Professor Farrand. Archæological work in this area requires much time and persistence, on account of the great scarcity of specimens in the shell mounds. On his return journey Mr. Smith investigated the Indian remains south of Spence's Bridge, and here also a gradual change of culture seemed to be revealed.

In 1899 the principal operations of the expedition were in Asia, as will be described later on; but Messrs. Hunt, Teit and Smith continued their researches. Mr. Smith turned his attention to the shell mounds and burial-cairns of northern Vancouver Island and the islands off the coast of Washington. Many of these cairns were explored, and the shell-heaps near which they were usually placed were examined. The cairns were found invariably to be of great age, and the skeletons which they contained were in a bad state of preservation, but much interesting information regarding the methods of burial of the prehistoric occupants of the region was brought to light, and much material for a study of their physical characteristics was obtained. Mr. Smith's work is the first comprehensive survey of the archæology of this region which has been made.

In 1900 Mr. Teit continued his work on the Salish tribes of the interior of British Columbia. Professor Boas first joined Mr. Teit, and undertook with him a journey on horseback to the villages of the Thompson Indians south of Spence's Bridge.

MR. JOCHELSON'S CAMP IN THE STANOVOI MOUNTAINS, SIBERIA

Then he proceeded to the coast, and by appointment met Mr. Hunt at the northern end of Vancouver Island. There he spent the whole summer, visiting the fishing villages of the Indians and carrying on studies on their languages and customs. He also made a collection of plaster casts of Indian types.

On his return journey Mr. Teit met Dr. John R. Swanton,who was about to visit Queen Charlotte Islands in order to study the Haida Indians. In September, 1900, Dr. Swanton was conveyed by steamer to Skidegate, where he located for the winter. The Haida, who in former times lived in numerous villages all along the coasts of the islands, are so much reduced in numbers that they are now confined to two villages, while a portion of the tribe has located in southern Alaska. After several months spent at Skidegate, Dr. Swanton went to Masset, the northern village of the Haida, by canoe, and later visited Alaska. Finally he returned to Skidegate to take up some loose ends of his work, and returned east after a stay among the Haida which extended over more than a year. His work was supplemented by that of Dr. Charles F. Newcombe, who visited all the deserted villages of the Haida in a small boat, getting information on their exact location and on the geography of the country. At the same time he made a collection of plants.

In the years 1901 and 1902 Messrs. Hunt and Teit continued their studies for the expedition.

The isolated tribes along the east coast of Asia embrace the Ainu of Yezo and Saghalin, the Gilyak of the Amur River, the Kamchadal of the Peninsula of Kamchatka, the Koryak of the north coast of the Sea of Okhotsk, the Chukchee of the extreme northeastern part of Siberia, the Chuvantzy of the region west of the Chukchee and the Yukaghir of the Kolyma. In comparatively recent times Tungus tribes have settled in the territory which was probably originally inhabited by the other tribes alone.

The investigations on the Amur River were intrusted to Dr. Berthold Laufer and Mr. Gerard Fowke. Dr. Laufer had devoted himself to the study of the Tibetan language and of the history of Asiatic cultures, and was well prepared to take up the

problems offered by the Amur tribes. Mr. Fowke had done much archæological work in America, and he was to carry on archæological researches in the Amur province. Unfortunately the departure of the expedition was delayed by the difficulty of obtaining the necessary permissions and passports from the Russian Government. These obstacles were eventually overcome through the assistance of the United States Embassy in St. Petersburg, and through the active interest taken in the investigations by the Imperial Academy of Sciences of St. Petersburg. Dr. Laufer and Mr. Fowke arrived at Vladivostok on June 19, 1898, and proceeded thence to Khabarovsk, on the Amur. Here they separated. Mr. Fowke descended the Amur in a boat, investigating the remains along both banks of the river.

Dr. Laufer went down the river by steamer, and crossed to the Island of Saghalin, which he reached on July 10, 1898. He staid on the island until March 21, 1899, investigating the Gilyak, Tungus and Ainu tribes. The fall of 1898 he spent among the Gilyak tribes of the northeastern part of Saghalin; later he travelled southward along the east coast of the island. Unfortunately in October, when visiting a Gilyak village about twelve miles inland, Dr. Laufer was taken ill with the grippe, which was followed by pneumonia, so that his investigations suffered a long interruption. When hardly well enough to resume his work, he journeyed southward, at first on horseback and then on reindeer-sledges, visiting the Tungus and Ainu of the central and southern parts of the island. When about to continue his journey farther southward, he received a telegram from the Russian Governor, informing him of the presence of a band of desperadoes, who had built a fort in that region and had terrorized the whole country. Nevertheless he spent enough time among the Ainu to collect a considerable amount of valuable information.

On March 4, 1899, he reported on the progress of his work as follows:

Among the collections which I made on the Island of Saghalin there are several very interesting specimens. I obtained from the Olcha Tungus a collection of wooden idols and amulets made of fish-

MR. JOCHELSON AND PARTY ON KORKODON RIVER, SIBERIA

skin which are quite new to science. I have had very good success in using the phonograph, and have obtained songs of the Gilyak and Tungus. Linguistic work on Saghalin was very difficult, because there are no interpreters capable of translating texts. There is no one who knows more than the most common phrases of Russian. Among the Ainu, Russian is entirely unknown; and for the purpose of interpreting I had to use Japanese, with which, however, they are not very familiar either. Nevertheless, my knowledge of the Japanese language facilitated my work among them since they like the Japanese people. I collected most of my material among the Ainu during the night-time, because it is only at this time that everything is active. There is a great difference between the Ainu dialects of Yezo and Saghalin, the latter being much more archaic. I did not succeed in obtaining any anthropometric measurements. The people were afraid that they would die at once after submitting to this process. Although I had their confidence, I failed in my efforts in this direction, even after offering them presents which they considered of great value. I succeeded in measuring a single individual, a man of imposing stature, who, after the measurements had been taken, fell prostrate on the floor, the picture of despair, groaning, "Now I am going to die to-morrow!"

I started comparatively late on my journey along the east coast of Saghalin, because I was detained for two months and a half by a severe attack of influenza. As soon as I had sufficiently recovered, I visited one of the Gilyak villages where the people were celebrating one of their bear festivals. I was welcomed with much delight, since I met several of my acquaintances of last summer. For five days I assisted in the ceremonial, and was even permitted to witness the sacrifice of the dog, which is kept secret from the Russians. . . . On New Year's eve I reached my southernmost point on the island. On the following day I took phonographic records of songs, which created the greatest sensation among the Russians as well as among the natives. A young Gilyak woman who sang into the instrument said, "It took me so long to learn this song, and this thing has learned it at once, without making any mistakes. There is surely a man or a spirit in this box which imitates me!" and at the same time she was crying and laughing with excitement.

On the 2d of January I started by dog-sledge northward. This journey was exceedingly difficult, and sometimes even dangerous. At one time I narrowly escaped drowning when crossing the ice at the foot of a steep promontory. I broke through the ice, which was

much weakened by the action of the waves. Fortunately my guide happened to upset his sledge at the same moment when I broke through. Thus it was that he saw my situation, and extricated me with his staff.

Toward the end of the month I arrived at Korsakovsk, making the last hundred versts (sixty-seven miles) on horseback. Originally I intended to return from this point along the west coast of the island; but this proved to be impossible, since there is no means of communication in winter. For this reason I had to return northward the same way that I came, and had to travel as rapidly as possible in order to reach Nikolayevsk in time, for by the end of March it becomes impossible to cross the ice between the island and the mainland. Therefore I returned with all possible speed; working and collecting, however, whenever opportunity offered.

On March 21 Dr. Laufer crossed to the mainland in order to take up his studies of the Gold, a Tungus tribe. He reached Khabarovsk on March 25. Since a considerable number of Gold are located at that point he settled there and carried on his investigations among the natives. By the end of May, navigation on the Amur being reopened, he started on a boat journey down the river, visiting villages of the Gold, and farther down those of the Gilyak. After reaching Nikolayevsk, he paid a visit to the Gold tribes on the Amgun River, and finally returned to Vladivostok. On October 19, 1899, Dr. Laufer started home, and after spending some time in Japan, reached New York early in 1900. Mr. Fowke had left Vladivostok a little earlier, and reached New York in the fall of 1899.

The plans for the work in the arctic part of Siberia were elaborated with the assistance of the Imperial Academy of Sciences of St. Petersburg. Professor W. Radloff, director of the Ethnographical Museum and a member of the Academy, suggested that the work be intrusted to Messrs. Waldemar Jochelson and Waldemar Bogoras, who had for several years carried on important studies in Siberia under the auspices of the Imperial Geographical Society. In the summer of 1898 Professor Boas visited Europe, and, after consultation with Professor Radloff, had a number of conferences with Mr. Jochelson, in which the

REINDEER-TEAMS TRANSPORTING MR. JOCHELSON'S OUTFIT ACROSS THE VERKHOYANSK MOUNTAINS

general plan of the expedition was decided upon. According to this plan, Mr. Jochelson was to undertake the study of the Koryak and Yukaghir; Mr. Bogoras, that of the Chukchee and Eskimo. Through their former expeditions Mr. Jochelson was already familiar with the Yakut and part of the Yukaghir, while Mr. Bogoras knew the western Chukchee intimately. The expedition was to begin in the year 1900. Mr. Bogoras was to stay among the Chukchee and Eskimo until the summer of 1901, while Mr. Jochelson proposed to begin his studies on the Sea of Okhotsk, and then to travel westward over the Stanovoi Mountains to the Yukaghir, whence he intended to return by way of Yakutsk and Irkutsk in 1902. Later this plan was slightly modified, in that Mr. Bogoras undertook the linguistic study of the Koryak, whose speech is closely related to that of the Chukchee.

Messrs. Jochelson and Bogoras reached New York in March, 1900. A considerable part of the outfit of the expedition had been purchased in Europe and shipped to Vladivostok direct. The rest of the purchases were made in America, and in April the party left San Francisco bound for Vladivostok, which was reached May 16. In New York Mr. Norman G. Buxton was added to the party. He was charged with the making of collections of zoölogical material. Mrs. Jochelson and Mrs. Bogoras, who were to share the hardships of the journey with their husbands, and to undertake part of the work of the expedition, had gone to Vladivostok by way of the Trans-Siberian Railway. Besides, Mr. Jochelson had engaged Mr. Alexander Axelrod of Zürich as a general assistant, particularly for carrying on the geographical work incidental to the expedition. Mr. Jochelson undertook the general leadership.

At Vladivostok the expedition separated into two parties. Mr. and Mrs. Jochelson and Messrs. Axelrod and Buxton were to make their headquarters at Gishiga; Mr. and Mrs. Bogoras, at Mariinsky Post, at the mouth of the Anadyr River. The Bogoras party left Vladivostok on June 14, on board the steamer "Baikal." The departure of the Jochelson party was delayed until July 24, because, owing to the political complications in China, the gov-

ernment transport "Khabarovsk," which visits Gishiga once every year, was employed for military purposes.

Mr. Jochelson reports on the progress of the expedition in his immediate charge as follows:

On August 16, 1900, we landed in Kushka, a small village at the mouth of the Gishiga River. The condition of affairs in the district of Gishiga was very sad. In the winter of 1899–1900 this region had been visited by an epidemic of measles. According to the church registers, 179 persons out of a total of 500 had died at Gishiga between December 25, 1899, and March 1, 1900. When we reached Gishiga, the grippe prevailed and everybody was sick abed. Contrary to my expectations, there were no Koryak near Gishiga. The Reindeer Koryak, who are in the habit of wintering near this place, had moved far into the mountains with their herds, in order to escape the ravages of the prevailing epidemic. Neither was it easy to reach the villages of the Maritime Koryak, which are located on Penshina Bay, east of Gishiga. There is no regular means of communication in summer, because at that season travel across the tundra by dog- or reindeer-team is impossible. Sea-going boats which could withstand the heavy seas at Cape Taigonos, between the bays of Gishiga and Penshina, were not available, so that, in order not to lose the remaining summer months, I made up my mind to attempt the tundra with pack-horses. These, however, were hard to get. There were sixty-five horses in all, in the region, the property of the Russian inhabitants of Gishiga. Most of these had been hired by a Russo-American gold-mining company, which was represented by an American engineer, Mr. Shockley. After a great deal of trouble I succeeded in hiring twenty horses, some of which were almost too young for use. Mr. Buxton staid in Kushka in order to make zoölogical collections, while the rest of our party started on September 10.

We were accompanied by a Cossack, an interpreter and two packers, who also served as guides. The trail across the boggy tundra and over the hills was very difficult. Pack-horses as well as saddle-horses became mired and had to be extricated, so that we did not average more than ten miles a day. One day, while our Cossack and interpreter were hunting two pack-horses that were carrying provisions and had run away up a side valley, I tried to proceed on my journey, accompanied by Mrs. Jochelson and Mr. Axelrod. We ex-

pected soon to overtake our guides, who had gone ahead with the rest of the pack-horses; but when ascending a hill we lost the trail, and for two days we wandered about in the high, treeless tundra without food, fire or protection against wind and frost. At length we gathered a large pile of wood and started a fire, the smoke of which was discovered by our men, who had been searching for us all the time. At the foot of the last pass we had to cross we were overtaken by a snowstorm, which detained us for three days. At length on October 5, we reached Paren, a winter village of the Koryak. The village, however, was deserted, since the people were still living in their summer village, about fifteen miles distant. I sent my men to notify them of our arrival, and on the following day two skin boats arrived at the mouth of the river to convey us to the village Kuel, on the river of the same name. Before our departure from Paren, I sent back my two guides with the horses, which were exhausted by the long journey. The return journey of these men lasted eighteen days, and was full of accidents. In a snowstorm they lost six horses, the men themselves almost perished of cold and hunger, and after their arrival in Gishiga six more horses died of exhaustion.

After our arrival at Kuel, our investigations began. During the first half of the winter 1900–01 we carried on our work in the villages of the Maritime Koryak of the bays of Gishiga and Penshina. The second half of the winter was spent in the camps of the Reindeer Koryak in the interior of the country. When the winter trails were in good condition, I went to Gishiga to replenish my provisions and barter, and then we started with twenty dog-sledges for Kamenskoye, where I staid for some time.

While we were located at this place, Mr. Bogoras came overland on a visit from Anadyr, and spent the month of December with us. During this time he was engaged in studies of the Koryak language. After his arrival, I sent Mr. Axelrod to Anadyr to take charge of Mr. Bogoras's station until his return. Mr. Bogoras completed his linguistic studies, and then proceeded to visit the villages of northern Kamchatka. After his return, Mr. Axelrod staid with him at Anadyr.

In all my journeys I was accompanied by Mrs. Jochelson, who, being a candidate for the degree of medicine at the University of Zürich, took charge of the anthropometrical and medical work of the expedition and of most of the photographic work.

While among the Maritime Koryak, we lived most of the time in

their underground dwellings, which are reached by a ladder leading down through the smoke-hole. It is almost impossible to describe the squalor of these dwellings. The smoke, which fills the hut, makes the eyes smart. It is particularly dense in the upper part of the hut, so that work that has to be done in an upright position becomes almost impossible. Walls, ladder and household utensils are covered with a greasy soot, so that contact with them leaves shining black spots on hands and clothing. The dim light which falls through the smoke-hole is hardly sufficient for writing and reading. The odor of blubber and of refuse is almost intolerable; and the inmates, intoxicated with fly agaric, add to the discomfort of the situation. The natives are infested with lice. As long as we remained in these dwellings we could not escape these insects, which we dreaded more than any of the privations of our journey.

The winter tents of the Reindeer Koryak are so cold that we could not work in them; therefore we had to put up a tent of our own. It was furnished with a small iron stove, and there we carried on our ethnological and anthropometrical work. At night, however, the tent was very cold, and we slept in bags made of wolf-skins. While on the way, we spent the nights on the snow, covered with fur blankets. Several times we were exposed to snowstorms, and had to wait under our blankets, covered with snow, until the gale was over.

In May we returned to Kushka, and I was engaged until June in packing up and cataloguing the collections which we had made in the winter. In June we started in two boats on the dangerous journey to the mouth of the Nayakhan River. At that time there were assembled at this place more than sixty tents of nomadic Tungus whom I proposed to visit. On our return journey the tempestuous sea drove us into the Bay of Atykyna, where we had to stay for five days, almost without any provisions. Fortunately on the fourth day of our stay my men killed two seals. In July I made a trip by boat from Gishiga to the mouth of the river Ovekova, where I visited a camp of Maritime Koryak. This was my last stay with the Koryak, and on July 28 I returned to Kushka.

While Mr. Bogoras's party was returning to Vladivostok from Mariinsky Post, and while Mr. Buxton was waiting for the steamer that was to take him back, I had to stay another year in northeastern Siberia, the object of my further investigations being the study of the Yukaghir of the Kolyma.

CHUKCHEE

KORYAK

YUKAGHIR

TUNGUS

GILYAK

AINO

SIBERIAN TYPES

After the necessary preparations had been completed, I started with Mrs. Jochelson on August 15 from Kushka, on our journey across the Stanovoi Mountains to the Kolyma. I had hired twenty saddle- and pack-horses from the Yakut, and was accompanied by four Yakut packers, one Tungus guide, one Tungus interpreter and one Yukaghir chief.

Our journey from Kushka, at the mouth of the Gishiga River, to Verkhne-Kolymsk, on the Yassachna River, a tributary of the Kolyma, took fifty-six days—from August 15 until October 9, 1901. We were the first whites to cross the Stanovoi Mountains at this point. In winter, nomadic Tungus visit this country, but in summer it is deserted by all human beings. This journey was the most difficult one that it was ever my fate to undertake. Bogs, mountain torrents, rocky passes and thick forests combined to hinder our progress. Part of our provisions consisted of bread and dried fish. A heavy rain which fell during the first few days of our journey soaked the loads of the pack-horses and caused the provisions to rot. Therefore we had to cut down our rations from the very beginning. After crossing the passes of the Stanovoi Mountains, we reached the upper course of the Korkodon River. By this time our horses were exhausted, and it was necessary to take a long rest. Meanwhile the cold was increasing day by day, and haste was necessary if we were to reach Verkhne-Kolymsk before the closing of the river. Therefore I left three Yakut with the horses and the goods, and prepared to descend the river on a raft with the rest of my party, hoping thus to reach a camp of the Yukaghir which is located on the course of the Korkodon.

It took us one day to build a strong raft, and then we began the descent of the river, made dangerous by numerous rapids and short bends, by the rocky banks and by jams of driftwood. Our guides had intimated that we could make the descent in two days, but instead we spent nine days on the raft. It was my desire to leave ample provisions with the three Yakut who staid with the horses, and for this reason I had reduced our own allowance to the very lowest limit. Thus it happened that three days' rations had to last us through the nine days which we spent on the raft. For the last six days we had to be satisfied with forty-five pounds of flour, or an allowance of two cups a day for every person and a little tea without sugar.

We spent four days among the Yukaghir of the Korkodon, and after finishing our work and purchasing a supply of fish, we continued our journey to Verkhne-Kolymsk in a boat down the Korkodon and

the Kolyma. The journey took seven days. In the night following the seventh day the river froze up while we were still forty miles from our goal. We left the boat, and after a tramp of two days reached Verkhne-Kolymsk on October 9, 1901. There I found the goods which I had sent ahead in 1900 from the Bay of Ola. From Verkhne-Kolymsk, a village of eight houses and one church, I visited the Yukaghir of the River Yassachna. It was December 8 when the Yakut whom I had left on the Korkodon reached Verkhne-Kolymsk. Then we proceeded to Sredne-Kolymsk, the capital of the district and a town of five hundred inhabitants, arriving there December 24. On January 6, 1902, we continued our journey to Nishne-Kolymsk, and then to the Yukaghir of the tundra west of the Kolyma. February 15 we returned to Sredne-Kolymsk, and March 6 started on our return journey. Passing Verkhoyansk we reached Yakutsk April 25, 1902.

The condition of affairs in northeastern Siberia happened to be very unfavorable during the time of my visit. A famine prevailed among the Yukaghir of the Yassachna. I assisted them as far as I could, and sent a messenger to Sredne-Kolymsk to request the assistance of the government. In the spring of 1902 the inhabitants of three Yukaghir tents on the Omolon were found starved to death. Even in Sredne-Kolymsk the fishing had been a complete failure, and the people were compelled to kill their dog teams because they could not feed them. Hunting on the tundra had also been a failure. Besides this, there were unusual demands made upon the horses and reindeer that are used as means of conveyance on the post-road from Yakutsk to Kolymsk, so that the animals were quite exhausted. On this road we met officers from Yakutsk, government messengers, and members of several expeditions:—the Mammoth expedition of the Imperial Russian Academy of Sciences, part of the polar expedition of Baron von Toll, and the English newspaper expedition of Harry de Windt. For these reasons the conveyance of the Yukaghir collections to Yakutsk was very difficult. We spent some time in the district of Yakutsk, where I made a Yakut collection. We started homeward July 16, 1902; reached Irkutsk August 8, where we took the railroad for St. Petersburg, and finally arrived at New York November 18, 1902.

The distance covered by myself and Mrs. Jochelson from Gishiga to Irkutsk amounted to nearly eight thousand miles. The results of our work are complete studies of the ethnography and anthropology of the Koryak and Yukaghir, illustrated by extensive collections.

These collections embrace three thousand ethnographical objects, forty-one plaster casts of faces, measurements of about nine hundred individuals, twelve hundred photographs, one hundred fifty tales and traditions, phonographic cylinders, and skulls and archæological specimens from abandoned village sites and from graves. I also made a small zoölogical collection, and obtained a large mammoth tusk weighing two hundred twenty pounds. During the whole period of my absence I kept a meteorological journal.

Mr. Jochelson does not state in this report that on his whole journey overland to the Kolyma, and from there through the district of Yakutsk, certain Russian officials, following a secret order issued by the Minister of the Interior, did all they could to hinder the progress of the expedition and to thwart its success. This action seems difficult to understand, in view of the hearty support and assistance rendered by the Imperial Academy of Sciences and the open letters issued by the Russian Government, requesting the officials of Siberia to render assistance whenever possible.

Mr. Bogoras gives the following description of his expedition:

We left Vladivostok June 14, 1900, for Mariinsky Post at the mouth of the Anadyr River, taking the only regular means of conveyance, the Russian mail steamer, which visits the place but once a year. Contrary to my expectations, I had not been able to charter a special steamer to carry the Anadyr branch of the Jesup North Pacific Expedition to the Chukchee Peninsula.

Mariinsky Post is the most remote settlement of the Russians in northeastern Asia. We arrived there after a five weeks' journey. A detachment of Cossacks is stationed there, by the side of a small native village. The Cossacks live in barracks built of timber and covered all over with earth. The native village is the southernmost settlement of the Maritime Chukchee, and is distant several days' journey from the nearest village of the same tribe. On account of an epidemic of measles which was ravaging the Chukchee villages, I could not hire a boat's crew for a journey to the north. Therefore I had to delay my visit to the northern villages until the next spring, when I crossed Holy Cross Bay on the ice. Before starting I had arranged to meet Mr. Jochelson at Kamenskoye, on the Sea of Okhotsk, where I was to spend some time studying the Koryak language. I also

thought that it would be possible to proceed from Kamenskoye to northern Kamchatka, in order to study such remnants of the Kamchadal language and folk-lore as might still exist in some remote villages, and then to return to Anadyr in time for a journey northward.

I spent the first four months of my field-work at the mouth of the Anadyr, visiting the camps of the Reindeer Chukchee, which during the summer are scattered on the seashore. I made collections and took photographs and anthropometrical measurements. During this time I also made a study of the language of the Ai'wan tribe, which forms the main branch of the Asiatic Eskimo. In this I had the aid of two Ai'wan families who live with the Chukchee at Mariinsky Post. The conditions of the summer were rather unfavorable. An epidemic of measles brought by a Russian trader from Vladivostok to Kamchatka the previous year swept along the shores of the Sea of Okhotsk and of Bering Sea, carrying away hundreds of victims. In some places the fatality amounted to about thirty per cent. of the whole population. In the summer of 1900 it reached the Pacific shore of the Chukchee Peninsula, where the loss of life was just as considerable. Therefore the summer fair which is held at Mariinsky Post early in August every year was not visited in 1900 by any of the native traders from the northern Chukchee and the Eskimo villages.

About the end of October, a considerable time after the freezing of the Anadyr River, I left Mariinsky Post, together with one of my Cossacks, bound for the village of Markova on the middle Anadyr, from there to Kamenskoye on the Okhotsk Sea. From that period till the end of my field-work I spent my time in continuous travel, and did not remain at any one place more than three or four weeks. Mrs. Bogoras staid on the Anadyr till the next summer, traveling between Mariinsky Post and Markova, and making the greater part of the collections for the Museum, while I spent my time chiefly in collecting scientific information. She was assisted by Mr. Axelrod, whom Mr. Jochelson sent to Mariinsky Post from Kamenskoye.

We traveled almost exclusively with dogs, several of which I bought from the natives, picking out the best, and from time to time exchanging for fresh ones those that became unfit for further travel. Of these dogs I formed three teams, which allowed us to travel fast enough, when the weather and the conditions of the snow were favorable. We could carry no heavy loads, however, and had to leave everything behind except our scientific instruments and a few objects for barter. This obliged us to rely almost wholly on the food-supply

MARKOVA, ON ANADYR RIVER, SIBERIA, MOST EASTERN TOWN OF RUSSIA. VISITED BY MR. BOGORAS

of the country, and during the whole time we lived on dried fish, reindeer-meat, seal and walrus blubber etc. I found it more difficult to get food for my dogs than for ourselves especially in the spring, when food is scarce in the maritime villages. Thus we were obliged to carry some dog-food all the time, which lessened still more our carrying-capacity for other purposes. In traveling I was usually accompanied by one Cossack and a native guide. Each of us drove his own team of twelve animals.

The winter of 1900–01 was very severe in the Anadyr country. It began with heavy snowfalls, which were followed by a general thaw. The moss pastures were covered with a crust of ice, and thus the reindeer herds were half starved because they could not break the ice with their hoofs. Therefore the winter fairs were sparsely attended, the people remaining scattered all around the country, unable to undertake any extensive journeys. Blizzards were frequent, and directly after leaving Mariinsky Post we were overtaken by one which lasted several days and spoiled the track to such a degree that our dogs were hardly able to drag themselves through the deep snow. We had to make the greater part of the journey to Markova on snow-shoes and assist our teams in dragging the sledges.

I reached Kamenskoye after a month's journey, and found Mr. and Mrs. Jochelson there. Near the end of December, after four weeks' stay, I left Kamenskoye, and went across the plateau of Parapolsky Dol to the first villages of the Kamchatka Koryak, and thence to the villages of the western Kamchadal, on the west coast of the Kamchatka Peninsula. There, in eight villages, I found that the Kamchadal language was still spoken, though rapidly giving way to Russian. The language was found to belong to the same stock as the Chukchee and the Koryak. In several details the Kamchadal language appears to be more complicated and probably more ancient than the two northern dialects.

About the end of February I left Kamchatka and started on my return journey to the Anadyr, along the Pacific coast, through a part of the country hitherto wholly unknown and unexplored. The journey had to be made hurriedly, because I had to reach Mariinsky Post on March 25, since I had left directions with the Anadyr branch of the expedition to have everything ready by that time for a journey northwards. Unfortunately I was taken ill with influenza in one of the Kamchatka villages and lost my voice temporarily, so that I could communicate with the natives only by means of signs during

more than a fortnight. At one time, indeed, my illness became so alarming, that the Cossack, who also felt responsible for the success of the expedition, asked me for instructions as to which way to carry my body and my "official papers" in case I should die on the route. I ordered him to tie up everything in curried leather, and to take it with all possible despatch to the Anadyr.

My route lay across the border-line between the Koryak and the Chukchee reindeer-breeders, who in former times were involved in continuous warfare with each other, and then along the line of Kerek villages. The latter are a branch of the Maritime Koryak, who live in the most remote part of the country, which is very poor in natural resources. In former times they lived chiefly on walrus; but within the last few decades, *i. e.*, since the arrival of American whalers has driven the walrus farther to the north, they have been rapidly dying out from continual starvation.

Between the Kerek villages and the first camps of the Anadyr Reindeer Chukchee lies an uninhabited, mountainous country. It is unknown to the Kerek, who therefore could not supply us with guides, and we had to pass through it, guided solely by the course of the frozen mountain rivers up to the watershed, and then down to the tributaries of the Anadyr. This journey lasted seventeen days, and nearly exhausted the strength of both dogs and drivers.

I reached Mariinsky Post on March 26, and after a stay of two weeks started northward with a party of native traders, who were returning from the annual traffic with the Anadyr Cossacks. I was accompanied by Mr. Axelrod and four Russianized natives with extra teams, carrying provision and wares for barter. During this journey Mr. Axelrod made a survey of the overland route. A journey of four weeks brought us to Indian Point, where we staid about a month, during which time I made a boat journey to St. Lawrence Island. My studies at that place were devoted to the Maritime Chukchee and Asiatic Eskimo.

At the end of June I started on my return journey towards the mouth of the Anadyr. For this purpose I bought the frame of a native boat and had it covered with walrus hides. Our journey in this boat lasted thirty-two days, and we arrived at Mariinsky Post on July 28, 1901, ten days before the arrival of the annual postal steamer which took us back to Vladivostok. From there I shipped our collections to New York by way of Suez, while we returned over the Trans-Siberian Railway to St. Petersburg. There I was unfor-

tunately taken ill, and was unable to return to New York until April 17, 1902.

The results of this work are studies of the ethnography and anthropology of the Chukchee and Asiatic Eskimo, and partly of the Kamchadal and of the Pacific Koryak. These studies are illustrated by extensive collections, embracing five thousand ethnographical objects, thirty-three plaster casts of faces, seventy-five skulls and archæological specimens from abandoned village sites and from graves. Other material obtained includes three hundred tales and traditions; one hundred fifty texts in the Chukchee, Koryak, Kamchadal and Eskimo languages; dictionaries and grammatical sketches of these languages; ninety-five phonographic records, and measurements of eight hundred sixty individuals. I also made a zoölogical collection and kept a meteorological journal during the whole time of my field-work.

The investigators who took part in the field-work of the expedition are all engaged in studies of the materials collected. Some of the results have been published, but much remains to be done. It is of course premature to draw any final conclusions from the materials collected, because the greater part is not yet available for purposes of comparison, and the investigation of the anthropometrical material has not even been taken up. It seems clear, however, even at this time, that the isolated tribes of eastern Siberia and those of the northwest coast of America form one race, similar in type, and with many elements of culture in common. It would seem that the unity of race was much greater in former times than it is now; that the invasion of eastern tribes in America, such as the Eskimo, Athapascan and Salish, and of western and southern tribes in Asia, such as the Yakut and Tungus, have disturbed the former conditions. Nevertheless enough remains to lead us to think that the tribes of this whole area must be considered as a single race, or at least that their culture is a single culture, which at one time was found in both the northeastern part of the Old World and the northwestern part of the New World. Thus the Jesup Expedition seems to have established the close relationship between the peoples of Asia and America.

The following Museum memoirs have been published, embodying results obtained by the Jesup North Pacific Expedition. The number of the volume is that which each bears in the series of Museum memoirs.

Vol. II. Anthropology.

Part I. — Facial Paintings of the Indians of Northern British Columbia. By Franz Boas. Pp. 1–24, pll. i–vi. June 16, 1898.

Part II. — The Mythology of the Bella Coola Indians. By Franz Boas. Pp. 25–127, pll. vii–xii. November, 1898.

Part III. — The Archæology of Lytton, British Columbia. By Harlan I. Smith. Pp. 129–161, pl. xiii, and 117 text figures. May, 1899.

Part IV. — The Thompson Indians of British Columbia. By James Teit. Edited by Franz Boas. Pp. 163–392, pll. xiv–xx, and 198 text figures. April, 1900.

Part V. — Basketry Designs of the Salish Indians. By Livingston Farrand. Pp. 393–399, pll. xxi–xxiii, and 15 text figures. April, 1900.

Part VI. — Archæology of the Thompson River Region. By Harlan I. Smith. Pp. 401–442, pll. xxiv–xxvi, and 51 text figures. (With title-page, contents, and index to Vol. II.) June, 1900.

Vol. IV. Anthropology (not yet completed).

Part I. — Traditions of the Chilcotin Indians. By Livingston Farrand. Pp. 1–54. June, 1900.

Part II. — Cairns of British Columbia and Washington. By Harlan I. Smith and Gerard Fowke. Pp. 55–76, pll. i–v, and 9 text figures. January, 1901.

Part III. — Traditions of the Quinault Indians. By Livingston Farrand, assisted by W. S. Kahnweiler. Pp. 77–132. January, 1902.

Part IV. — Shell-Heaps of the Lower Fraser River. By Harlan I. Smith. Pp. 133–190, pll. vi, vii, and 59 text figures. December, 1902.

MARIINSKY POST, SIBERIA. COLLECTIONS OF JESUP NORTH PACIFIC EXPEDITION READY FOR SHIPMENT

Vol. V. Anthropology (not yet completed).

PART I. — Kwakiutl Texts. By Franz Boas and George Hunt. Pp. 1–270. January, 1902.

PART II. — Kwakiutl Texts (continued). Pp. 271–402. December, 1902.

Vol. VII. Anthropology (not yet completed).

PART I. — The Decorative Art of the Amur Tribes. By Berthold Laufer. Pp. 1–79, pll. i–xxxiii, and 24 text figures. January, 1902.

ETHNOGRAPHICAL ALBUM.

Ethnographical Album of the North Pacific Coasts of America and Asia. Part I, pp. 1–5, pll. 1–28. August, 1900.

Among those in preparation are:

Vol. IV, Part V. — The Lillooet of British Columbia. By James Teit.

Vol. VII, Part II. — The Chukchee. By Waldemar Bogoras.

Vol. VIII, Part I. — The Haida of Queen Charlotte Islands, B. C. By John R. Swanton.

Ethnographical Album of the North Pacific Coasts of America and Asia. Part II.

NEWS NOTES

THE Department of Vertebrate Palæontology has recently received two very handsome gifts: the skull of the white rhinoceros of Africa from J. Pierpont Morgan, Esq.; and casts of the skull, brain cavity and foot of two species of Uintatherium, a cast of the skull and jaw of *Brontops robustus* and a cast of the skeleton of *Anchisaurus*, presented by the Yale University Museum through Professor Charles E. Beecher.

PROFESSOR J. E. DUERDEN, Honorary Curator of Cœlenterates, who has spent the past year as interim professor of biology

at the University of North Carolina, was at the Museum for a few days in July, on his way to England. He will spend the next academic year at the University of Michigan, as acting assistant professor of zoölogy.

Professor Henry Fairfield Osborn spent several weeks in August and September visiting the various places in the West, where the Department of Vertebrate Palæontology has been carrying on field work during the past season. These localities, as stated in the July number of the Journal, were Fort Bridger and vicinity, Reed and Bone Cabin Quarries in Wyoming, and the southwestern part of South Dakota.

Dr. E. O. Hovey of the Department of Geology visited Vienna in August to represent the Museum at the ninth triennial meeting of the International Geological Congress. He gave a public lecture before the congress on the recent volcanic eruptions on the islands of Martinique and St. Vincent.

Mr. Frank M. Chapman's quest for birds and accessories in California, mentioned in the last number of the Journal, was very successful and he brought back to the Museum a large amount of material from which groups will be constructed for our exhibition halls, as well as specimens for the research collections and numerous photographs.

Mr. W. Beutenmüller's expedition to North Carolina in May and June for insects was very successful. A full account of the trip may be expected in a future number of the Journal.

The Collection of Fossil Vertebrates

A Guide Leaflet to the Exhibition Halls
of
Vertebrate Palæontology
in the
American Museum of Natural History

By
W. D. MATTHEW, Ph.D.
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PUBLISHED BY THE MUSEUM
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Guide Leaflet No. 12

PREFATORY NOTE

The collection of fossil vertebrates belonging to the American Museum of Natural History comprises the extensive material collected by the late Professor E. D. Cope chiefly between 1870 and 1890 and the much larger collections made by the expeditions which have been sent out by the Museum every year, beginning with 1891. Most of the Museum expeditions have worked in the western States.

From the beginning of the department in 1891 the collection and exhibition of these fossils have been under the direction of Professor Henry Fairfield Osborn, the curator. From 1891 to 1898, inclusive, the exploring parties in the field were under the immediate supervision of Dr. J. L. Wortman. Since that time Messrs. Matthew, Granger, Brown and Gidley have been in charge of the field work.

The funds necessary for sending out the expeditions and for the purchase of the Cope Collection have been furnished chiefly by President Jesup and Messrs. Osborn, Whitney and Constable. The exhibit illustrating the evolution of the Horse is mostly the gift of Mr. William C. Whitney.

Editor.

HALL OF FOSSIL MAMMALS

THE COLLECTION OF FOSSIL VERTEBRATES.

By W. D. Matthew, Ph.D.,

Associate Curator, Department of Vertebrate Palæontology.

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How they come to be Buried, Fossilized, Found and Collected. Plesiosaurs. Mosasaurs. Ichthyosaurs. Fishes.

East Wing. No. 406. *Fossil Mammals* 12

Arrangement. Titanotheres. Rhinoceroses. Horses. Primitive Hoofed Mammals. Primitive Clawed Mammals. Elephants, Mammoths and Mastodons. Artiodactyls. South American Fossil Mammals. Instances of Evolution. Restorations. Transparencies. Charts, etc.

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Introduction.

When we dig beneath the present surface of the ground we sometimes find remains of ancient cities, dwellings, bones of men and animals, buried many centuries ago under accumulations of débris, deposits of river mud or drifted sand. From these have been gleaned many facts concerning the early history of mankind of which there is no written chronicle. From the study of these facts the science of Archæology has arisen, the science which deals with the early history of mankind, with the evolution of civilization.

Most of the lower animals of which the archæologist finds traces are like those now living, although a few have become extinct. But in those more ancient deposits which are now consolidated into clays, sandstones etc., indica-

What Fossils Are.

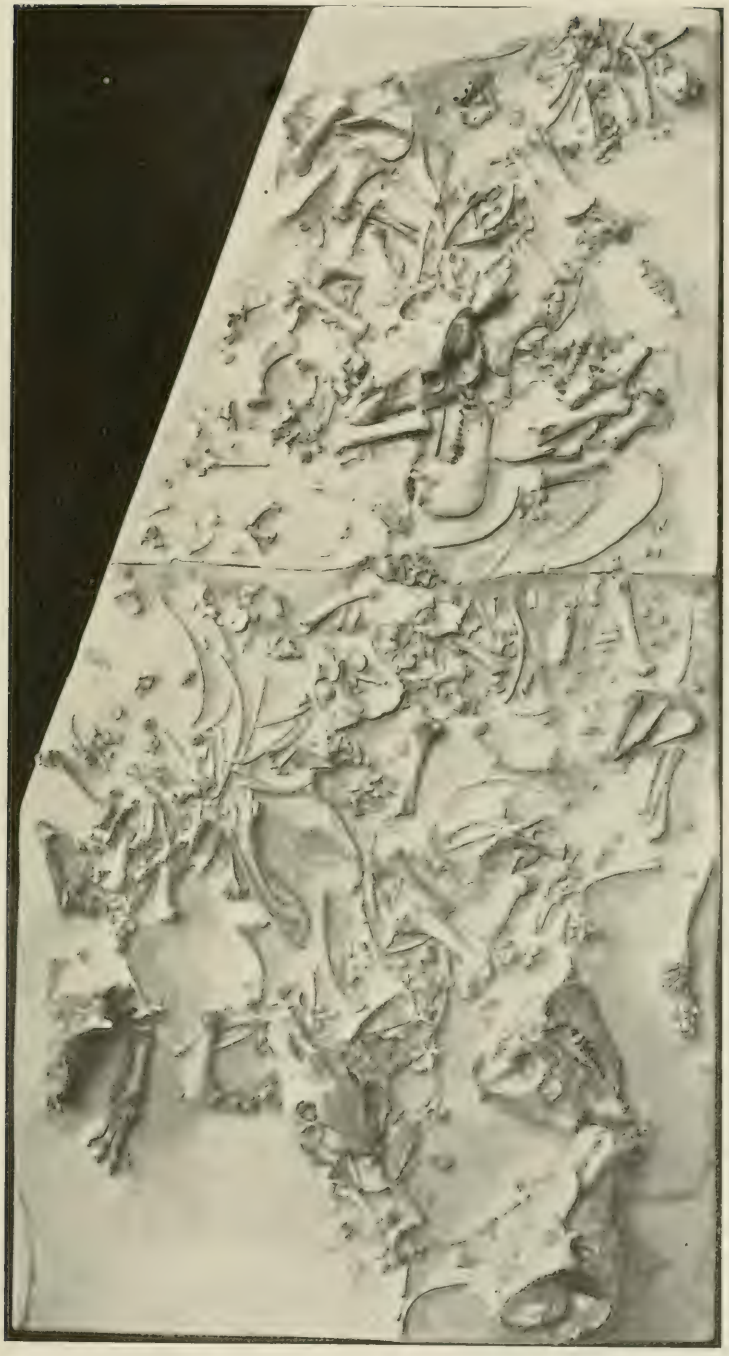
tions of man are not found, and the remains of lower animals which they contain are unlike any now living—the more unlike as the rock is more ancient. These remains are called *fossils*. They consist only of the hard parts of animals (bones, shells, spines etc.). The soft parts are never preserved, and only very rarely is some trace of skin or hair, horns or hoofs, to be distinguished. As in the course of ages the mud or sand in which they are buried changes to rock, so little by little the fossils have been changed by heat, pressure and especially by the slow infiltration of mineralized waters into brittle, stony material, while retaining their outward form and usually their peculiar structure. But mud and clay, in changing into rock, settle down and contract considerably, and the fossils are flattened out correspondingly, sometimes to such a degree, in the case of a rock which has once been a soft, oozy mud, that they suggest rather a picture or a bas-relief than the original form of the animal. The fossil skeletons of marine reptiles and fishes on the walls of the corridor hall and in the case opposite the elevator have been flattened out in this manner, especially the Ichthyosaur skeletons.

Science of Palæontology.

From fossils we can interpret the history of the world of life during the long ages before man appeared. The science which deals with the ancient history and evolution of the animal kingdom is Palæontology (*παλαιός*, ancient, *ὄντα*, living beings, *-λογία*, science). It tells us of a long period of time before Man appeared, probably millions of years, during which Mammals of great size and unfamiliar form were the dominant animals—of a yet longer era before that, during which huge Reptiles were rulers of earth, sea and air—and of other still more ancient periods during which Amphibians, Fish and Invertebrate Animals held sway in turn. Vertebrate Palæontology deals only with the higher classes of fossil animals, the Vertebrata, or those that have backbones (fish, amphibians, reptiles, birds and mammals).

Geological Time.

Earth-history or geological time has been divided into many parts according to the evidence furnished by the rocks and the fossils contained therein. The principal subdivisions are shown in the accompanying table:



FOSSIL SKELETONS IN THE ROCK

This slab of soft chalky clay contains five skeletons of an extinct animal. One is an old male, the other four are young

GEOLOGICAL ERAS, PERIODS AND AGES.

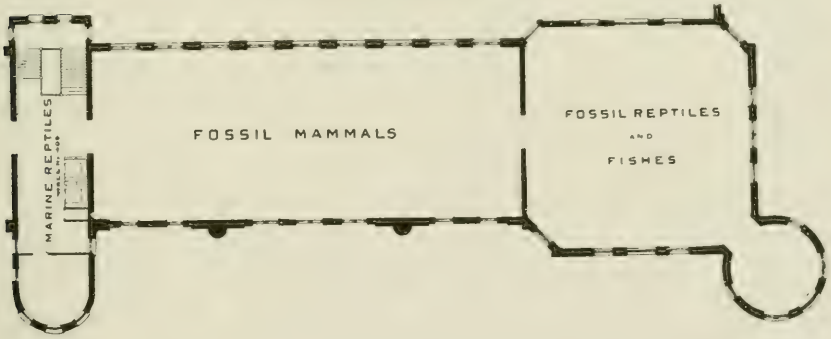
Eras.	Periods.	Ages.
Cenozoic	Quaternary	Age of Man, 50,000 years
	Tertiary	Age of Mammals, 3,000,000 years
Mesozoic	Cretaceous	Age of Reptiles, 7,000,000 years
	Jurassic	
	Triassic	
Palæozoic	Permian	Age of Amphibians and Coal Plants, 5,000,000 years
	Carboniferous	
	Devonian	Age of Fishes, 2,000,000 years
	Silurian	Age of Invertebrates, 10,000,000 years
	Cambrian	
Eozoic	Algonkian	(No fossils)
	Archæan	

The estimates in years of the geological periods given in this table, which is arranged in descending order from the most recent to the most ancient time, must be understood to be merely very rough approximations. There is no known method of finding any exact equivalent in years of any geological period, although the relative length of each to each is much more nearly known. The estimates given herewith are based on the careful study of the subject made by C. D. Walcott, Director of the U. S. Geological Survey. In concluding his discussion Dr. Walcott stated his belief that the duration of geological time (the entire period included in this table) might be measured by tens of millions of years, but not by single millions or by hundreds of millions.

To give the visitor a clear idea of these extinct animals, the skeletons usually have been removed entirely from the rock in which they were found and have been mounted as much as possible like skeletons of modern animals. To mount a petrified skeleton in this manner is a very difficult matter, for such skeletons are rarely perfect, and the bone is always very brittle and more or less shattered and crushed out of shape. In the mounted skeleton the missing parts have been restored in tinted plaster, modeled from other individuals or from nearly related animals in which these parts are known. The outlines of the restored parts of bones are marked off with red lines, while entire bones modeled in plaster are marked with a red cross, or with a red circle if supplied from other individuals. All the skeletons are original specimens except the *Megatherium* at the far end of the hall; and all are of extinct animals except a few which are placed with the others for comparison. With each fossil skeleton will be found, besides a descriptive label, a small model and a water-color restoration of the animal, showing its probable appearance during life and indicating its supposed habitat. The transparencies in the windows show the localities where the fossils are found, chiefly in the Bad-lands of the western States.

How Fossil Skeletons are Mounted.

General Arrangement.



The collections are arranged to illustrate the geological history and evolution of the different groups of Vertebrata, especially those of North America. They fill two large halls and a corridor.

General Arrangement of Collections.

East Wing. Hall No. 406. Fossil Mammals.

East Wing. Hall No. 407. Fossil Reptiles, Amphibians and Fishes.

In addition

East Corridor, No. 405 (in which are the elevator and stairways), contains fossil Marine Reptiles and Fishes of the Age of Reptiles.

SKELETON OF THE GREAT MARINE LIZARD IN THE EAST CORRIDOR

THE EAST CORRIDOR. No. 405.

The Preservation of Fossils in the Rocks.

On stepping from the elevator the visitor sees before him a case filled with skulls and skeletons of the marine reptiles and fishes which inhabited the great inland sea that once spread over the center of the North American continent, from Canada to Mexico. The reptiles were of kinds now long extinct, *Plesiosaurs* with long snaky neck, short bulky body with long flippers and stubby tail, and *Mosasaurs* with short neck and longer tail. Some of the fishes were ancestors, collateral or direct, of certain modern fishes, others belonged to groups now extinct. These animals lived and died, their carcasses sank to the bottom of the sea, and were buried in whatever sediment was being deposited there—soft white ooze in the open sea, dark gray or black mud nearer the shores. In the course of ages this ooze or mud settled gradually and consolidated into chalk or shale. Afterwards as the continent rose above the waters and assumed more nearly its present dimensions, the rivers flowing over the broad plains excavated

HUNTING FOR FOSSILS IN THE BAD-LANDS

Members of the American Museum Expedition of 1894 in the Uinta Basin, Utah

broad shallow valleys in the chalk and shale. In the dry climate of the present day the sides of these valleys often are bare rock, carved by wind and the infrequent storm-bursts of rain into the fantastic maze of cliffs and winding cañons known as "bad-lands." Here and there, projecting from an outstanding ledge or trailing in fragments down some crumbling slope, a fossil bone may be seen by the trained eye of the collector as he searches along the rock exposures; and quarrying in around the bone he is sometimes rewarded by a skull, sometimes by a string of vertebræ, occasionally by a whole skeleton, buried in the rock except for such parts of it as have been weathered out and washed away.

The Finding and Collecting of Fossils.

To excavate the fossil without damaging the brittle bones, buried as they are in a weak and shattered mass of heavy shale or chalk, is a slow and delicate operation, requiring special methods and considerable care and skill. Then the specimen must be packed, and sent in to the Museum, where the rock is removed and the specimen is prepared for exhibition. When the bones are as much crushed and distorted as those represented in the photograph (page 10) the matrix is removed from one side only, and the specimen is thus placed on exhibition.

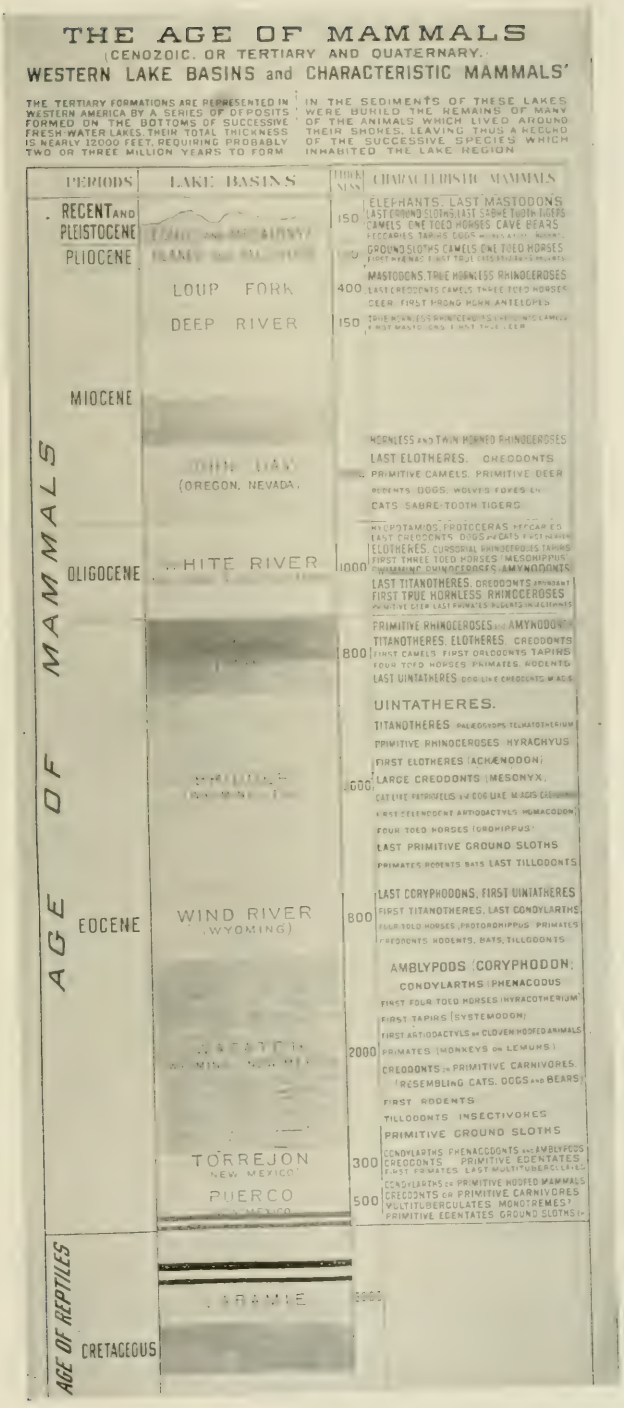
Temporarily placed in the bottom of the case is a large Plesiosaur skeleton, only partly removed from the rock. This specimen unfortunately lacks the skull. Beside the lower stairway is a Mosasaur skeleton, the finest specimen of its kind ever found, and above it is a large fish skeleton which was found in the same strata in western Kansas. Beside the upper stairway are three skeletons of Ichthyosaurs, another long extinct group of marine reptiles, of fish-like appearance, paralleling the modern Whales among mammals.

Important Specimens in Corridor.

EAST WING. HALL NO. 406. FOSSIL MAMMALS.

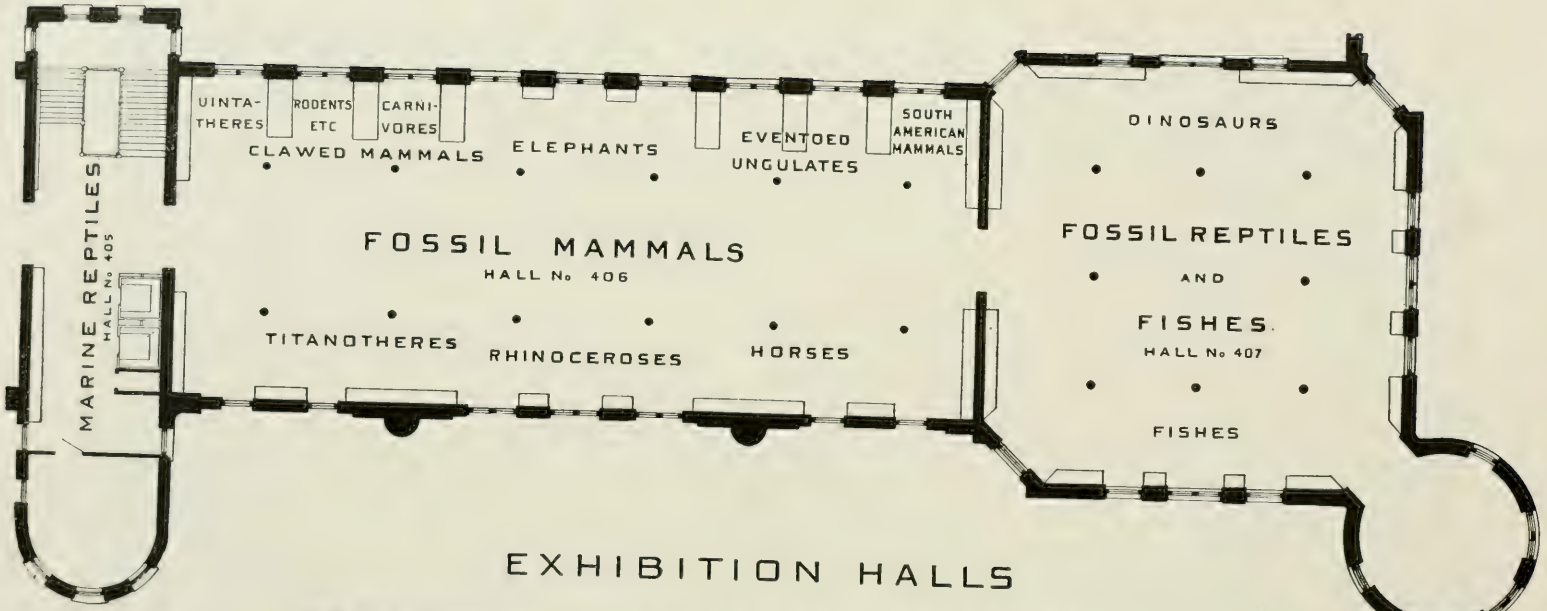
The ancestors of our modern quadrupeds are to be found in the East Wing, No. 406, together with many extinct races more or less nearly related to them. All the fossil specimens of each group of mammals are placed together in one alcove, where they have been arranged according to their geological age. Thus all the fossil Horses, direct

Arrangement of the Fossil Mammals.



DIVISIONS OF THE AGE OF MAMMALS

Characteristic fossil mammals, and the geological formations in which they are found



EXHIBITION HALLS

DEPARTMENT OF VERTEBRATE PALAEONTOLOGY

or collateral ancestors of the modern Horses, Asses and Zebras, are in one alcove, arranged in series from the most ancient to the most recent. The most ancient and structurally primitive groups of mammals come first, the most modern and familiar types come last.

	South (Right) Side.	North (Left) Side.	
Perissodactyls or Odd-Toed Hoofed Mammals	TITANOTHERES	AMBLYPODS	Primitive Hoofed Mammals
	Chalicotheres	CONDYLARTHS	
		Monkeys, Bats, Rodents, Insectivores and other Small Primitive Mammals	
		Marsupials	
		CREODONTS	Carnivorous Mammals
		CARNIVORES	
		Seals, Dolphins, Whales, Sirenians etc.	Marine Mammals
	Tapirs	MASTODONS and ELEPHANTS	Proboscideans
	Lophiodonts		
	RHINOCEROSES	ELOTHERES	Artiodactyls or Even-Toed Hoofed Mammals
		Anthracotheres	
		Pigs and Peccaries	
		OREODONTS	
		CAMELS	
	Palæotheres	DEER etc.	
	HORSES	Litopterna	Fossil Mammals Peculiar to South America.
		Toxodontia	
		Typotheria	
		EDENTATA	

SOUTH (RIGHT) SIDE.

The south side of the hall is entirely devoted to the Perissodactyls or Odd-Toed Hoofed Mammals in which the number of toes (in the hind foot and generally in the forefoot) is either 1, 3 or 5, while in the other main division of hoofed animals, the Artiodactyls, it is either 2 or 4; or more exactly, the axis of symmetry of the foot passes through the central toe in Perissodactyls, while in Artiodactyls it passes between two toes.

South Alcove 1. Titanotheres

The Titanotheres come first in the series of Perissodactyla, large animals which suggest rhinoceroses in general proportions, but have a differently shaped head and peculiar teeth. These began as hornless animals of moderate size (Cases 1 and 17) and increased in size and developed large bony horns (Cases 3, 5 and 19) before they

became extinct. The Titanotheres occupy the first of the three main alcoves into which the south side of the hall is divided.

The second alcove is devoted to the RHINOCEROSES, which

RESTORATION OF TITANOTHERIUM, AN EXTINCT HOOFED MAMMAL OF WESTERN AMERICA

The picture shows a bull, a cow and a calf

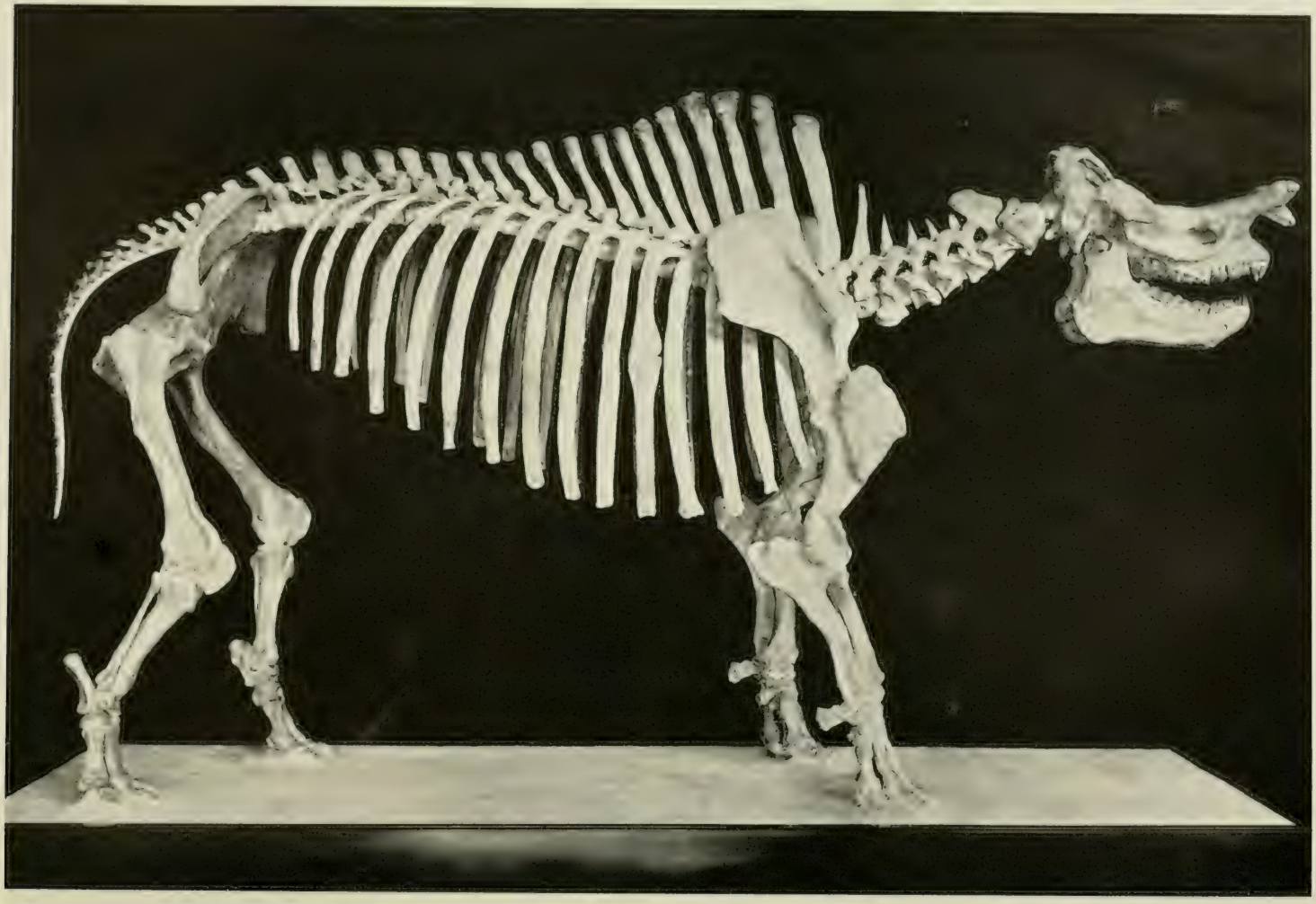
From the original water-color, based on mounted skeleton and skulls in American Museum of Natural History

were very common beasts in North America as well as in the Old World during the Tertiary period. They also began in the Eocene as small hornless animals (*Hyrachyus*, Case 7), but diverged in the Oligocene into cursorial, aquatic and true (terrestrial) Rhinoceroses of which the two former soon became extinct. True Rhinoceroses also became extinct in America by the Pliocene epoch, while in the Old World several of them have survived to the present day.

South Alcove 2. Rhinoceroses.

Third Alcove. HORSES.[1] This fine exhibit is due chiefly to

[1] For more detailed information regarding the evolution of the Horse, see Guide Leaflet No. 7, "The Evolution of the Horse." Published January, 1903.



MOUNTED SKELETON OF THE TITANOTHERE, FROM THE BIG BAD-LANDS OF SOUTH DAKOTA

the liberality of Mr. Wm. C. Whitney. The Evolution of the Horse is illustrated by a series of feet and skulls, and of complete skeletons, from the little Four-Toed Horse of the Lower Eocene to the different varieties of the modern animal. The construction of the modern Horse, structure of the bones, the way in which the teeth grow, characters of the different races of domestic Horse and of the different wild species are shown in the end case (Case 15).

South Alcove 3. Horses.

NORTH (LEFT) SIDE.

First come the AMBLYPODS and CONDYLARTHS. These groups of Primitive Hoofed Mammals are first found in the lowest Eocene strata, at the very beginning of the Age of Mammals and they became extinct before the end of the Eocene epoch. Like so many other races the Amblypods begin with small hornless animals (*Pantolambda*) and finally develop into huge elephantine beasts (*Uintatherium*) with six horns on the skull, and great sabre-like tusks. The Condylarths were more slender types, fitted for running. The best known among them is *Phenacodus*, which is considered to represent very nearly the prototype of the hoofed mammals, although it was not the direct ancestor of the later groups.

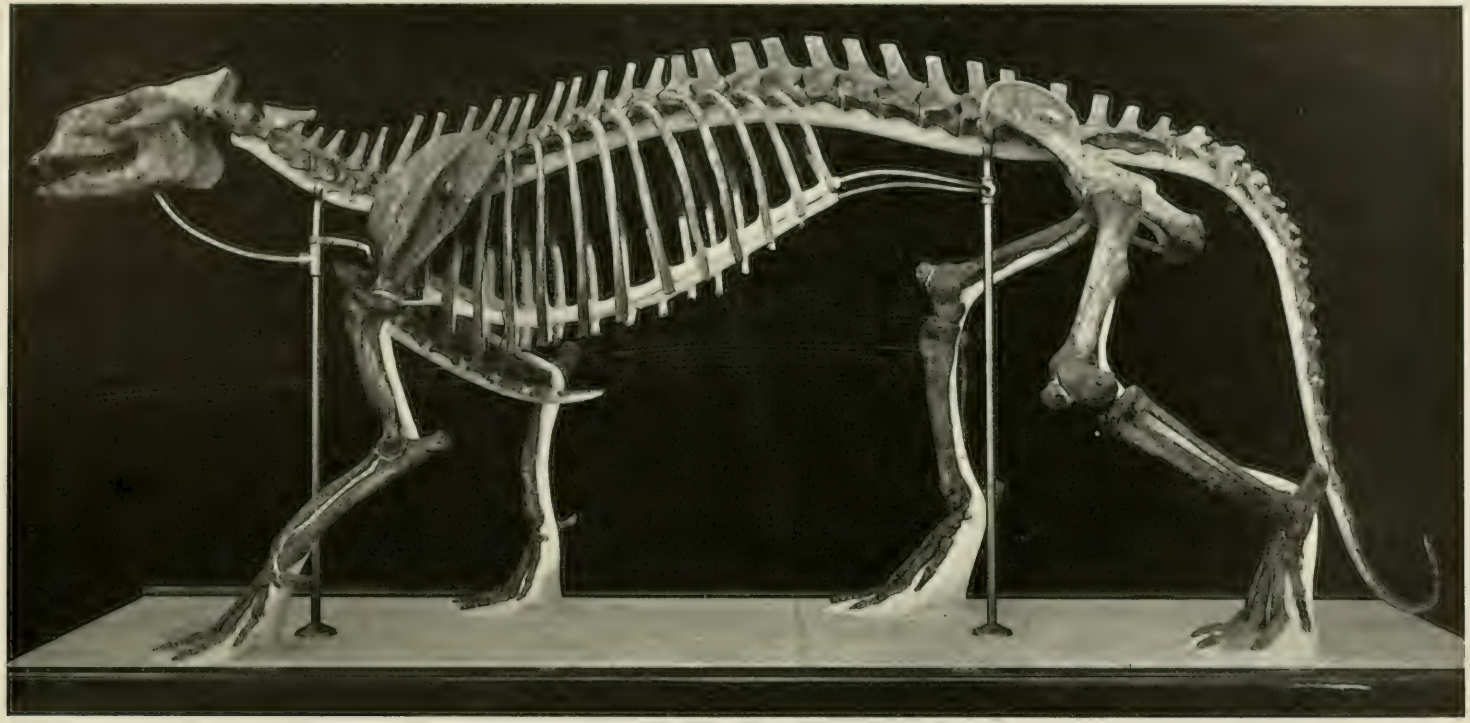
North Alcove 1. Amblypods, etc.

The second alcove is devoted to Rodents, Insectivores, Bats, Marsupials and other groups of small mammals, among which are the ancestors of the Monkeys and Lemurs and collateral ancestors of Man. Most of these remains are small and incomplete. Here are also some very fragmentary remains of ancient and primitive mammals which represent all that we know of the evolution of the mammalia during the Age of Reptiles, before the Age of Mammals began. These teeth and jaws are of interest because they are the oldest of mammals, from some of which are probably descended all the later mammal groups.

North Alcove 2. Small Mammals.

In the third alcove are the Carnivorous Mammals, on one side the CREODONTS or Primitive Carnivora, on the other the True CARNIVORA (Dogs, Cats, Bears, Martens etc.), represented by a number of finely preserved mounted skeletons, and a large series of skulls, together with other specimens.

North Alcove 3. Carnivora.



MOUNTED SKELETON OF PHENACODUS IN NORTH ALCOVE 2

This animal, although not a direct ancestor, represents the prototype of the hoofed mammals

Most remarkable among extinct carnivora are the Sabre Tooth Tigers, in which the upper canine teeth are enlarged into long, curving, flattened, serrate fangs, most terrible weapons, effective no doubt against the thick hides of the primitive pachyderms.

North Alcove 4. Marine Mammals.

The fourth alcove is very narrow. In it are placed a few remains of fossil marine mammals: Seals, Cetaceans and Sirenians. These groups are very imperfectly known as fossils.

North Alcove 5. Proboscidea.

The fossil ELEPHANTS and Mastodons are in the next broad alcove, about the middle of the hall. The evolution of these animals is shown by a series of skulls. The Mastodon skeleton and the skull and fore-limb of the Imperial Mammoth from Texas, and tusk of the Siberian (Hairy) Mammoth are noteworthy specimens.

North Alcove 6. Elotheres.

Beyond the Elephants are the ARTIODACTYLS or Cloven-Hoofed Mammals. They divide into two groups, typified by the Pigs and the Ruminants, the latter including the greater part of modern hoofed mammals, but by no means proportionally common as fossils. First among the fossil artiodactyls are the Elotheres, an extinct race of large animals distantly related to Pigs and Hippopotami. Next are the fossil Peccaries; then the Oreodonts, pig-like animals with the teeth of ruminants, very abundant in America during the middle and later Tertiary, but extinct before the Pliocene epoch. Then come the Camels, which although now found only in Asia and South America, originated in North America, and afterwards migrated to these other continents and became extinct in their native land. The evolution of these animals is shown by a series of stages only less complete than the stages in the evolution of the Horse.

North Alcove 7. Pigs, Peccaries, Oreodonts, Camels.

The higher ruminants (Deer, Antelope, Sheep and Cattle) are rather poorly represented in the collections. The Great Irish Deer is the most striking among the extinct species; attention is also called to the mounted skeletons of *Protoceras*, a deer-like primitive ruminant of the Oligocene epoch, and of *Merycodus*, a graceful little animal of the Miocene epoch intermediate between the Deer and the Prong-horn Antelope.

North Alcove 8. Deer, Antelope etc.

SKULL AND TUSKS OF THE IMPERIAL MAMMOTH

From a photograph of the specimen on exhibition in the American Museum of Natural History'

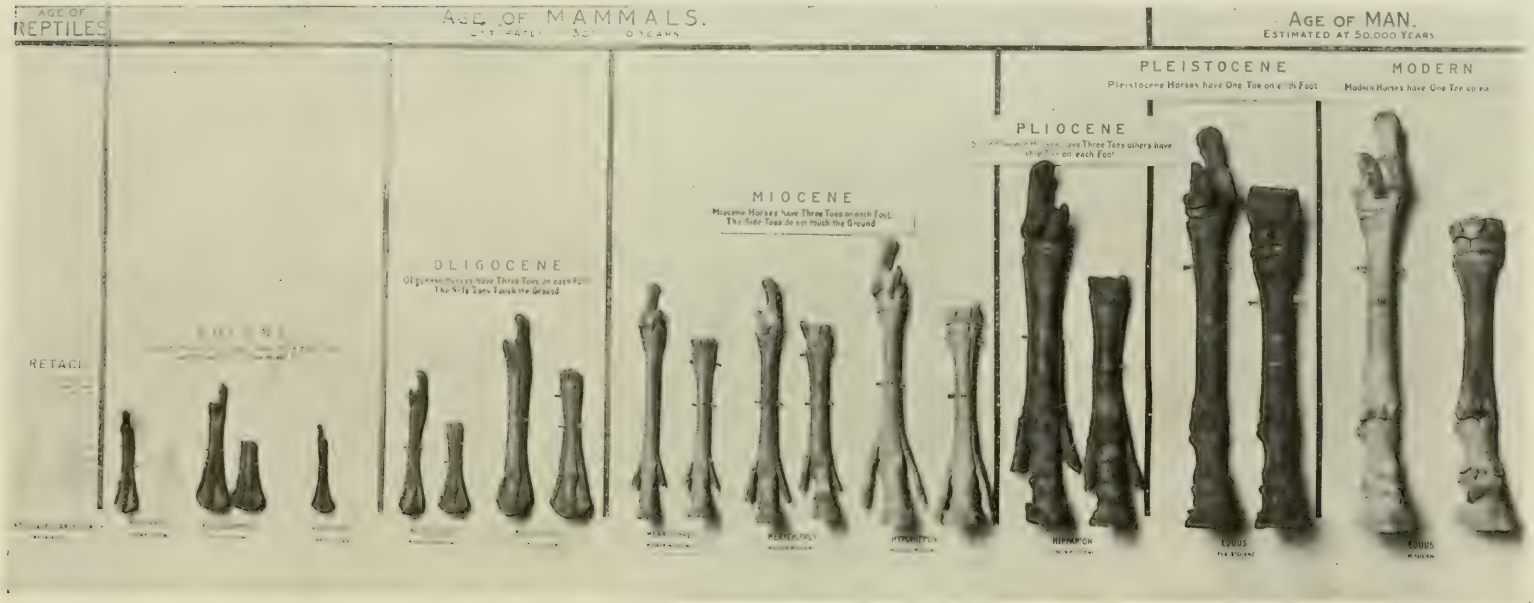
The northeast corner of the hall is devoted to a number of peculiar groups of SOUTH AMERICAN FOSSIL MAMMALS, almost all extinct. During the Age of Mammals the two great northern continental areas were joined together from time to time, so that there has been an occasional interchange of animals and plants among them, the races developed in one continent spreading to the other. The animals of North America therefore, although mostly of species distinct from those of Europe and Asia, are more or less nearly related to them. But during most of the Age of Mammals South America was an island continent, as Australia is still; and its extinct animals are as peculiar and as different from those of the rest of the world as are the living animals of Australia different from those of other continents. It is by no means certain where these animals originally came from, but there is much evidence to show that both South America and Australia were peopled from an Antarctic continent, now sunk beneath the ocean or buried in the ice fields of the more frigid climate of modern times.

North Alcove 9. South American Fossil Mammals.

Of these peculiar South American groups the most extraordinary are the Edentates, including the Sloths, Armadillos and Anteaters which still survive, and the huge MEGATHERIA or Ground-Sloths and GLYPTODONTS or Tortoise-Armadillos which have become extinct. Others were the TOXODONTS, TYPOTHERES, ASTRAPOTHERES and LITOPTERNA, peculiar groups of hoofed animals all now extinct. Some of the Litopterna lost their side toes and evolved into a one-toed race curiously like the horses of the northern hemisphere, although not at all related to them; this is one of the most interesting examples of the parallel adaptation of two different races of animals to similar conditions of life; the horses in the plains and prairies of the north, the litopterna in the pampas of the southern continent.

The best example of the evolution of a race of animals is shown in the southeastern corner of the hall. Here is exhibited the *Ancestry of the Horse*, the specimens from successive geological strata showing how the modern Horse has descended from diminutive ancestors with four toes on each forefoot and three on each hind foot, and with teeth and other

Instances of Evolution.



EVOLUTION OF THE HORSE. FEET

parts of the skeleton different from those of their modern representatives.

Almost equally complete, although less familiar, is the series illustrating the *Ancestry of the Camel*, which may be found on the north side of the hall near the east end. These animals, like the Horses, evolved from small and primitive ancestors to large and highly specialized descendants, and then became extinct in their former home, the broad and arid plains of western America, before the advent of civilized man, but survived to modern times in other parts of the world (Asia, Africa and South America). Less complete series are the skulls and skeletons illustrating the ancestors of Titanotheres and the ancestors of Rhinoceroses. These are ranged along the south side of the hall beginning at the entrance.

All these series have been placed according to geological age. The most ancient specimens, found in the lowest rock-strata, and hence representing the earliest stage of evolution, are placed first in the series. The most recent ones, found in the uppermost rock-strata, and representing the final stage of evolution of the race, are placed last. Arranging the species of a race from each stratum in the order of the age of the strata, we find that they show a regularly progressive change from the most ancient to the most recent. At no point in a given series can we draw a line and say: This is and that is not, a Horse—or a Camel—or a Rhinoceros. The visitor, therefore, can demonstrate for himself the evolution of the race of Horses or Camels or Rhinoceroses, within certain limits. Of the evolution of Man we have no satisfactory illustration from fossils.

It should be observed that the evolution of a race consists mainly in the adaptation of the structure of the animals to particular surroundings and habits of life. There is also a universal progress in intelligence, the more ancient animals having relatively smaller brains than their successors.

Water-color Restorations.

The water-color restorations by Charles R. Knight, done under the immediate supervision of Professor Osborn, mainly based on complete skeletons exhibited in this hall, show the *probable appearance* of the different extinct animals, according to our best judgment, as indicated by the characters of the skeleton, appearance of their nearest

surviving relatives and the habits of life for which the animals seem to have been fitted. The general proportions of the animal, the outlines and form of head and body, and, to a great extent, the expression of the features are usually accurately known from the fossil skeleton. The nature of the skin is sometimes but not often certainly known, and the coloring is always conjectural,

SCENE IN THE BAD-LANDS OF THE UINTA BASIN—TERTIARY FOSSIL FIELD OF NORTHEASTERN UTAH

the palæontologist and the artist having been guided by the coloring of living relatives and the supposed habits of the animal.

The window transparencies are enlargements from photographs of the regions where the fossils occur, and generally show the localities where unusually fine specimens in this hall were found. The expeditions sent out yearly to the fossil fields carry with them photographic outfits, and several hundred characteristic views have been taken, from

Window Transparencies.

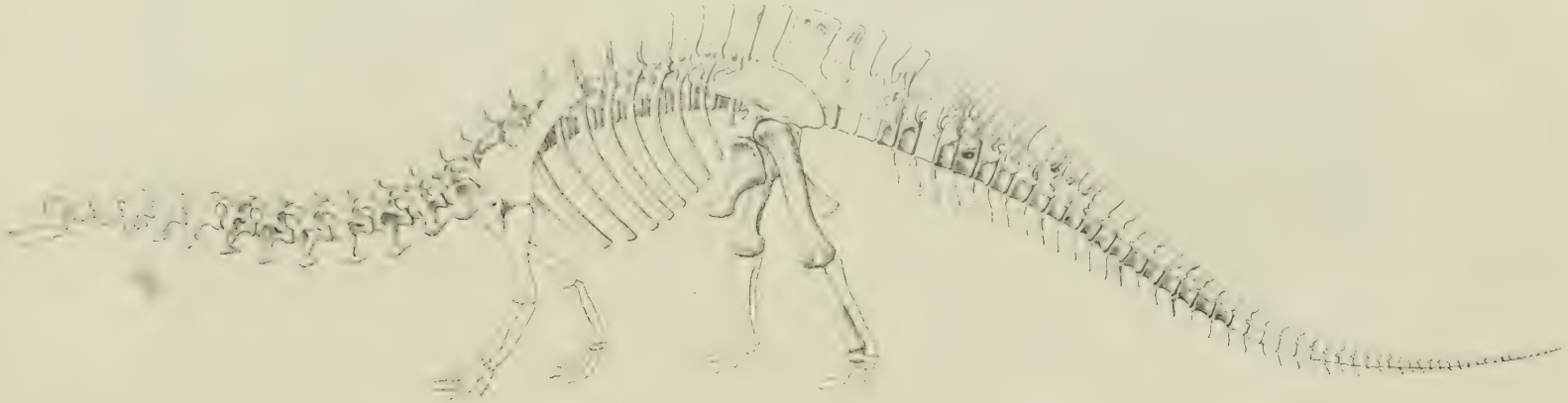
which these have been selected. The pillar cards and general labels in the cases give detailed information about each group of fossils. One of the cases in the center of the middle aisle illustrates the method by which the fossils are collected and conveyed to the Museum. The charts at each side of the entrance show the order in which the rock-strata lie, one over another, and the kinds of fossils found in each stratum.

EAST WING. HALL NO. 407. FOSSIL REPTILES, ETC.

This hall forms an introduction to an earlier world, the Age of Reptiles. These fossils are of strange and unfamiliar outlines, quite unlike ordinary quadrupeds; they represent an era, long since passed away, when reptiles were the "lords of creation." Chief among them were the Dinosaurs, great land and amphibious reptiles to which the greater part of this hall is devoted. They occupy the north, east and west sides and the center.

Amphibious Dinosaurs.

The AMPHIBIOUS DINOSAURS, on the west and north sides and in the center of the hall, were the largest of land animals, some of them sixty to seventy feet in length, and of enormous bulk. They were quadrupedal beasts, with long necks and long tails, and comparatively long and very massive limbs. The head was very small in proportion to the size of the animal, and the brain inferior to that of modern reptiles. They were cold-blooded, slow-moving, unintelligent creatures, vast storehouses of flesh which lived and grew to huge size with but little occasion for very active exertion amidst the rich vegetation of the moist and tropical climate of the reptilian era. Several incomplete skeletons of Amphibious Dinosaurs are exhibited, besides limbs and other separate parts. The Brontosaurus skeletons in Case 1 (on the right-hand or south side of the entrance) and in the center of the hall are among the largest. The thigh bone in this animal was nearly six feet long and weighs in its petrified state 500 to 600 pounds. The *Diplodocus* (Case 2 on the left-hand or north side of the entrance) was less robust but almost as long. This specimen lacks the fore part of the skeleton and most of the limbs, but the tail is very perfectly



SKELETON OF BRONTOSAURUS

RESTORATION OF THE SKELETON OF AN AMPHIBIOUS DINOSAUR OF THE AGE OF REPTILES. THE SKELETON WAS 65 FEET LONG

TAKING UP FOSSIL DINOSAUR BONES AT "BONE CABIN" QUARRY, WYOMING

Parts of several skeletons appear in the photograph

preserved. In Case 4 are limbs and other parts of several species of Amphibious Dinosaurs.

The Beaked Dinosaurs (Predentata) northeast corner of the hall, had a horny beak or bill at the front of the jaw, and teeth at the back of it. They were most extraordinary and bizarre animals, huge in size, although not so large as the Amphibious Dinosaurs. *Stegosaurus* had a series of great bony plates projecting from the back, and stout bony spines on the tail. *Triceratops* had an enormous skull with three great horns projecting forward, and a strong bony frill projecting backward around the neck. Both these were quadrupedal animals with massive limbs and elephantine feet. *Hadrosaurus* was a bipedal dinosaur with long hind limbs and three-toed bird-like feet, but with hoofs instead of claws. Its beak was broad and flattened, as in the spoon-bill duck or Ornithorhynchus of Australia.

Beaked Dinosaurs, Stegosaurus, Triceratops and Hadrosaurus.

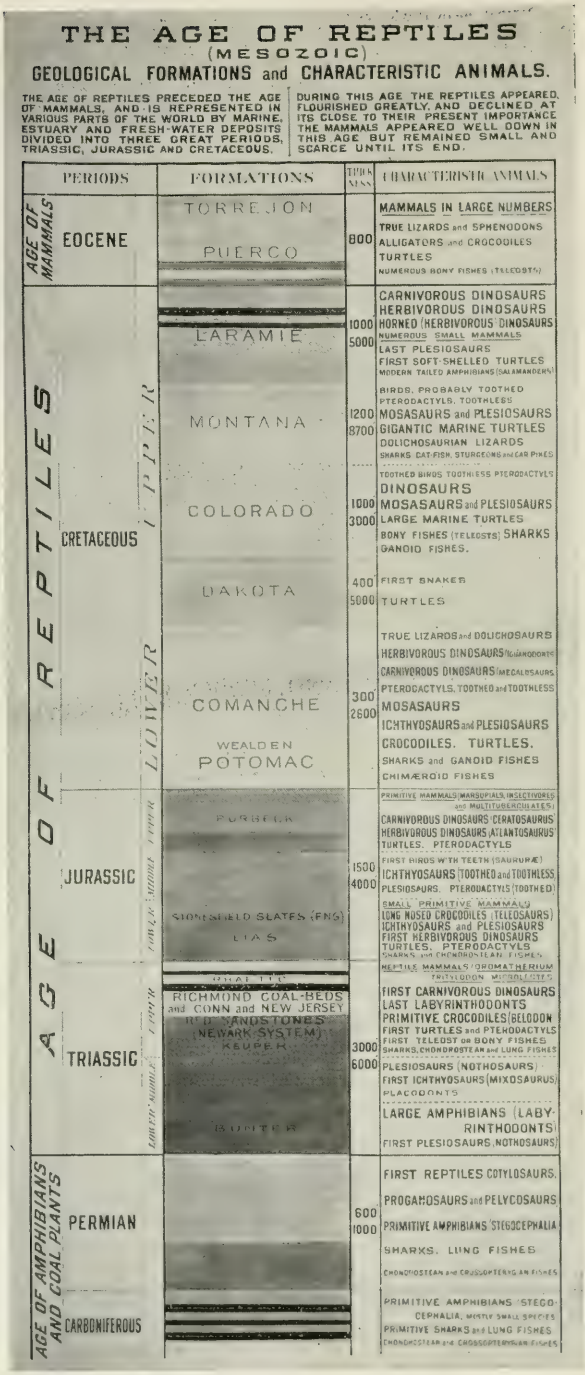
The Carnivorous Dinosaurs are exhibited on the east side of the hall (opposite the entrance). They were bipeds with bird-like feet, sharp claws and large heads with sharp-pointed teeth. Some of these, the Megalosaurs, were of gigantic size, much larger than any modern carnivore. *Allosaurus* was as large as an elephant, while other Megalosaurs were even larger. Other Carnivorous Dinosaurs, such as *Ornitholestes*, were small and of slender proportions; these probably lived on the small animals of that period—toothed birds, pterodactyls, small reptiles of various kinds—while the large herbivorous dinosaurians were more probably the chief prey of the Megalosaur.

Carnivorous Dinosaurs.

All the Dinosaurs had become extinct by the end of the Age of Reptiles. Their place was taken by the more intelligent and adaptable mammals, the evolution of which into the different kinds of modern quadrupeds has been seen in the Hall of Fossil Mammals.

Other Reptiles—Crocodiles, Turtles, Pterodactyls etc.

On the south side of the Fossil Reptile Hall are fossil remains of four other groups of reptiles, the Crocodiles, Turtles, Lizards and Snakes, which, more fortunate than the dinosaurs, have survived to the present day, though in much diminished numbers and importance.



DIVISIONS OF THE AGE OF REPTILES

Characteristic fossil reptiles, amphibians and fishes, and the formations in which they are found

Crocodiles in their palmier days were of world-wide distribution and comprised marine as well as fresh-water types. Turtles are among the commonest of fossils in the Bad-lands and some of them of very large size. Lizards and snakes, the only common reptiles of modern times, are very rare and fragmentary as fossils, and little is known about them.

Besides these surviving groups, several extinct groups of reptiles are shown on the south side of the hall. The Belodonts, of the dawn of the Reptilian Era, were partly intermediate between Dinosaurs and Crocodiles. The still older Pelycosaurs were remarkable for an enormous rigid bony fin on the back; among the contemporary Theriodonts there existed perhaps the remote ancestors of the Mammals. The Pterodactyls or Flying Reptiles were the most extraordinary of reptiles, tailless, with batlike wings, supported on the enormously lengthened little finger, and with a spread in the largest species of twenty feet from tip to tip. The Rhynchocephalians are an interesting group of very primitive reptiles, of which a single species, the Tuatara, still survives in New Zealand.

Fossil Amphibians.

The Age of Reptiles was preceded by an Age of Amphibians, when the dominant animals were allied to modern Frogs, Toads and Salamanders, but had the skulls covered by a solid bony roof and the bodies by more or less scaly armor. These Armored Amphibians have been called Stegocephalia (*στέγη, κεφαλή* = deck-head) or Labyrinthodonts (*λαβύρινθος, ὀδούς* = labyrinth-tooth, from the complicated fluting or infolding of the enamel on the teeth). Some of them, like *Eryops*, were large animals with heads eighteen inches long and a foot wide; others resembled colossal tadpoles; but the majority of them were quite small animals, either proportioned like salamanders or else long and eel-like with minute limbs or none at all.

Armored Amphibians (Stegocephalia).

These fossil Amphibians are the most ancient of fourfooted animals, and are not far removed from the central type from which all the higher vertebrates are believed to be descended. They are exhibited near the middle of the south side of the Hall of Fossil Reptiles.

Fossil Fishes.

Some of the finest specimens of fossil fishes in the collection are exhibited in the corridor hall. Others are placed in the southwest corner of the Fossil Reptile Hall. These range from the exceedingly ancient and archaic types, such as the huge Dinichthys of the Age of Fishes, older even than the fossil Amphibians, to more modern and familiar types such as the fossil Perch and Herring of the Green River Tertiary formation.

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Biological
& Medical
Serials

Natural history

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